

Aviation Week

and Space Technology

75 Cents

A McGraw-Hill Publication

May 9, 1960

**All-Glass Fiber
Rotor Blades
Undergo Testing**

**Saturn Eight-Engine
Rocket Cluster**



Safety, Reliability, Dictate Saturn Design

VOI-SHAN SCR-MAGNETIC PULSER FOR MAGNETRONS...

TRIMS PULSE JITTER TO LESS THAN .010 MICROSECOND DURATION—NOW AVAILABLE

Voi Shan Electronics' new SCR-Magnetic Magnetron Modulators replace and out date Thyristors with amplified solid-state circuitry utilizing silicon controlled rectifiers and adjustable cores. The result is unsurpassed life and reliability, assured by the use of refined potting techniques.

Voi-Shan modulators now in production have been use-proven at altitudes up to 300,000 feet—are smaller, lighter, and lower in cost than any previously available, and produce a finer spectrum. They operate off any available AC or DC prime power source—eliminating a separate high voltage power supply.

The configuration and specifications shown here can be readily modified to meet your own particular design requirements. For a prompt quote, contact Don M. Worden at the address below.

Voi Shan Electronics' activities include the design and manufacture of transistorized time delay relays, alternometers, sequential programmers, voltage sensors, frequency sensors, magnetic amplifiers and regulators, as well as programs encompassing traveling wave tubes and electro-mechanical counters. A request on company letterhead brings your free copy of our new electronics catalog.



MODEL M22 1000



SPECTRUM PLOT

SPECIFICATIONS, MODEL M22 1000

INPUT: 115 Volts 400 cps

OUTPUT:

Magnetron Pulse
Peak Voltage: 5-6 KV
Peak Current: 7.5 amps
Pulse Width: 5 microseconds (measured across 100 ohm load at 50% amplitude)
Rise Time: 50 to 20 microseconds (measured at 30% to 100% amplitude)
Pulse Repetition Frequency: 300 cps

Scram Trigger

Peak Voltage: —40 volts
Load: 50 ohms
Pulse Configuration: Same as Magnetron pulse

KEEP ALIVE VOLTAGE:

Open Circuit Voltage: —300 VDC
Closed Circuit Voltage: —250 volts

ENVIRONMENT:

Temperature: —55°C to +125°C
Altitude: 100,000 feet
Shock & Vibration: In accordance with MIL-T-24230

Mechanical:

Weight: 7.5 lbs.
Size: 120 cubic inches



Look— “instant” ground support!

Here's a brand of inflation that's easy to take—Goodyear's inflatable structures that can take to the air in folded form, blossom out on-site into tough, lightweight shelters, tent domes, fuel domes.

Shown above are a few recent developments in rubber used by Goodyear.

① **Rail Piles of Puller Tanks**—these huge containers can be set up, filled and pumping in minutes. Dressed, they roll up like a rug for compact storage and transport. Capable to 50,000 gallons or more.

② **Soft-Tip Radomes** by Goodyear provide all weather protection that shrugs off snow, ice, 150-mph gales. In sizes to 180 feet in diameter, Goodyear radomes offer highest transparency to radar waves. Even radar antennas are inflatable in new designs above.

③ **Personal Shelters** of Air Mat fold into light packs,

inflate in minutes. Provide comfort and protection in worst weather. Ability to hold air eliminates air-beds and need for constantly running compressors.

④ **Mobile Command Post** features Goodyear's 8-inch Air Mat fabric—with highest strength/weight ratio known. Stored in truck side, structure inflates and inflates to room 20-feet-square in 15 minutes.

Portable—lightweight—super-tough—flexible—these are the answer questions you can count on in Goodyear inflatables. But the real secret is Goodyear's design-engineering ability to fashion rubberized fabric into shapes and constructions you'd never think possible. And the odds are that our staff can fabricate the answer to your problem. Find out by writing or company letterhead to The Goodyear Tire & Rubber Company, Aviation Products Division, Dept. Q-1715, Akron 16, Ohio, or Los Angeles 54, California.

Lots of good things come from

GOODYEAR

MORE AIRCRAFT LAND ON GOODYEAR TIRES, WHEELS AND BRAKES THAN ON ANY OTHER KIND



2,880,830

You may not recognize U.S. Patent No. 2,880,830—but we know you are familiar with the part it describes—Shur-Lok's self-locking blind insert.



Featuring Shur-Lok's exclusive self lock, these sandwich panel fasteners are the strongest available to the missile and aircraft industries. You're probably using them now in such popular applications as aircraft cabin bulkheads and panels. These highly versatile fasteners function equally well in metal or non-metallic sandwich—making them ideal for use in trailer, marine, building and other industries.

If you have a fastening problem, Shur-Lok engineers can provide a solution with specialty fasteners to meet your specifications. Send details of your applications for study. Write today for our new fastener catalog.



FREE!

This highly informative report—"How you can Shur-Lok Design and Manufacture"—write for yours now!



279 South First Street
Anaheim, California

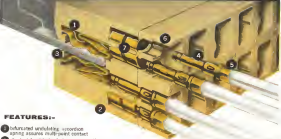
AVIATION CALENDAR

- (Continued from page 5)
- Nov. Conference, American Society of Mechanical Engineers, Station Bldg. Hotel, Dallas, Tex.
 - Nov. 14-16-1968 Meeting, Aviation Distribution and Manufacturers Assn., Queen Elizabeth Hotel, Montreal, Canada
 - Nov. 18-19-1968 Hotel Trades and Hotel Mechanics Institute, Sheraton, University Standard, Calif.
 - Nov. 22-24-1968 Conference on Small Cells and Electronic Measurements, NBS Boulder Laboratories, Boulder, Colo. Co-sponsored Institute of Radio Engineers Professional Group on Instrumentation Radio Standards Laboratory National Bureau of Standards, American Institute of Electrical Engineers, Instrumentation Division
 - Nov. 25-25-1968 Annual Meeting, Institute of Navigation, U. S. Air Force Academy, Colorado Springs, Colo.
 - Nov. 26-26-1968 Annual Meeting and Exposition, Federal American Society for Testing Materials, Chalfonte-Haddon Hall, Atlantic City, N. J.
 - Nov. 27-29-1968 National Convention on Military Electronics, Institute of Radio Engineers, Sheraton Park Hotel, Washington, D. C.
 - Nov. 28-28-1968 National Science Meeting, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif.
 - July 3-3-1968 Annual Fall Wayne National Championships (swims, track, cross-country, canoe, rowing, water polo), Wayne Field
 - July 15-19-1968 Liquid Rockets and Propellants Conference, American Rocket Society, Ohio Union Building, Ohio State University, Columbus, Ohio
 - July 24-24-1968 Annual Symposium on Computers and Data Processing, Denver Research Institute, University of Denver, Stanley Hotel, Estes Park, Colo.
 - Aug. 1-1-1968 Global Communications Symposium, Station Bldg. Hotel, Washington, D. C. Sponsored Institute of Radio Engineers, U. S. Army Signal Corps
 - Aug. 4-4-1968 National Meeting, Aerospace Administration Society, Olympic Hotel, Seattle, Wash.
 - Aug. 4-12-1968 Pacific General Meeting, American Institute of Electrical Engineers, El Comodoro Hotel, San Diego, Calif.
 - Aug. 20-20-1968 Annual Congress, International Association of Professional Engineers of Technology, Stockholm
 - Aug. 21-21-1968 Electronic Show, International Institute of Radio Engineers, National Hotel, Los Angeles, Calif.
 - Sept. 5-5-1968 Fundraising Dinner, Play and Exhibition, Society of British Aircraft Construction, Farnborough, Eng.
 - Sept. 12-12-1968 Annual General Meeting, SVTA, Copenhagen, Denmark
 - Sept. 12-12-1968 Second International Congress, International Council of the Aeronautical Sciences, Zurich, Switzerland
 - Sept. 21-21-1968 National Convention and Exposition, American Air Force Assn., Civic Auditorium and Sheraton Hotel, San Francisco, Calif.
 - Sept. 27-27-1968 Power Systems Conference, American Rocket Society, Marriott Hotel, Santa Monica, Calif. Co-sponsored USAF, U. S. Army, D. S. Navy, National Aeronautics and Space Administration, American Society of Engineers

NEWEST WITH BEST FEATURES



EDGE-ON HYFEN® PRINTED CIRCUIT CONNECTOR



FEATURES:-

1. deformed unloading, vibration spring assures multipoint contact
 2. shortest front to back dimension available—lightest in weight—no insulating sleeves needed
 3. closed entry face protects springs and self-aligns warped boards
 4. HYFEN type (straight shank/solid burr) have multi-point contact surfaces and independent detent locking action
 5. gold plated, crimp type, strap-in, removable HYFEN type with insulation grips take single or multiple leads
 6. closed entry on wire lead side prevents oversize probe damage
 7. 1 or 2 wire leads for each board position on each side
- low board insertion and withdrawal forces
 - designed for dry circuit as well as power applications
 - commencing clips and jumpers available for jacking circuits
 - planning key available for any selected position for pre-attached boards

BURNDY

HORRIGAN, CONNECT. • BCC-BURNDY LTD., LONDON, England • In Continental Europe: Amvex Belgium • TORONTO, CANADA

For drastic weight and space reduction!

For safest handling of cryogenic, exotic,
radioactive and conventional fluids!

Products of
COMPONENTS DEPT., RMD

For unsurpassed reliability!

VENTURI Shut-off VALVES

... in modern aircraft and
missile propulsion systems,
ground handling and nuclear applications

- No dynamic seals
- Full seal
- Low pressure drop
- High reliability
- Maximum of moving parts
- Zero leakage
- Low energy requirement
- Line pressure operated
- No external actuation
- Suitable for hazardous fluids, exotic fluids

The Venturi Shut-off Valves shown here are typical of the advanced valve design and development capability of Reaction Motors—present in rocket engines, missile components and support equipment. Capabilities include all facets of design, development and qualification testing of valves, gas pressure regulation and dampers. Complete in-house measurement of test facilities. Wide experience in designing for cryogenic, toxic, exotic and conventional fluids. Currently in production on large (11") ICHM space damper valves, ICHM regulators and X-15 components and valves for classified projects. *Reaction Motors can deliver valves designed to your special requirements within 6 to 22 weeks.*



2 1/2" Hydrogen Peroxide Valve

4" Decelerator Shut-off Valve

Cryogenic Fuel Valve

Gas-Liquid Venturi Shut-off Valve

COMPONENTS DEPARTMENT
REACTION MOTORS DIVISION

Thiokol CHEMICAL CORPORATION

Ford Road, Danville, New Jersey

NEW! ¹⁶ Low cost all-electronic totally-transistorized DIGITAL MULTIMETERS

Now in a single 5 1/4" x 8 3/4" x 1 9/16" panel
Digital Multimeters for measuring any
combination of AC/DC volts, AC/DC
mA/mA, and resistance, with new pre-amps
for higher sensitivities, optional electrical
output and print command capabilities!



FLIP-TOP BOX
CONSTRUCTION
FOR EASY
MAINTENANCE.

- 50 readings per second, average
- 1/2 sine "SUPER NOISE" readouts
- 0.01% accuracy
- 1000 megohm input impedance
- Automatic, manual and remote ranging
- Automatic polarity
- Two-Zener diode internal reference
- Front panel sensitivity control
- Dashed circuits, plug-in card construction
- Will operate directly in multi-point scanning and print-out data logging systems without any additional circuitry or auxiliary equipment.



New variations of these basic models including AC reference, milli-ohmmeters, micro-ohmmeters and specialized averaging multi-scale tailored to individual system requirements are available on the same physical subchassis. Ask your RT sales office or representative for complete specifications today!

Electro Instruments, Inc.

5000 AVENUE OF THE SCIENCES
SAN DIEGO 31, CALIF.

**NOW! A lightweight aircraft bolt with
220,000 psi tensile strength, 900°F maximum temperature**



The new LWR 922 aircraft bolt is another SPS development stemming from the critical need for increased strength-to-weight ratios in applications to 900°F.

The LWR 922 offers substantial weight savings over previous 220,000 psi bolts... without impairing mechanical strength or fatigue properties. Result: Fewer bolts are needed, however bolts can be replaced.

The reduced size of the bolt head allows closer installation to perpendicular bulkheads, with resultant structural weight savings. What's more, the design of the bolt provides a fastener compatible with the newer, high-strength elevated temperature materials.

220,000 psi

Characteristics of the LWR 922:

- Tensile strength—220,000 psi, minimum
- Endurance limit—220,000 psi at 10,000,000 cycles
- High retention of strength at temperatures to 900°F
- 30-K thread form for increased fatigue resistance
- Threads fully formed by rolling after heat treatment
- Continuous grain flow at head and shank
- Cold working of head-to-shank fillets
- Forged from 1% chromium, high-strength steel alloy
- Diffused nickel-sulfur: 5000 for corrosion resistance at high temperatures
- 100% magnetic particle inspection
- Available with compression lockwash—FN 922 Series—In size #10 through 1½ in.

900 °F

For complete technical data on the LWR 922 and the FN 922 and for new Bulletin 2122 and 2412

AIRCRAFT/MISSILE Division

SPS

JENKINTOWN 3, PENNSYLVANIA
SANTA ANA, CALIFORNIA

where reliability replaces probability

Atlanta, Ga. • Culver City, Calif. • Dallas, Tex. • Denver, Colo. • Fort Worth, Tex. • San Diego, Calif. • San Francisco, Calif. • Seattle, Wash. • Wichita, Kans.

3 dimension radar

with
longer range,
increased angular resolution,
higher data rate,
rapid electronic scan
and greater accuracy

lower production cost

Gilfillan



Advanced hot gas systems delivered by AiResearch

FOR OUTER SPACE, ATMOSPHERIC
AND UNDERWATER
STEERING



AiResearch is now in production on two greatly simplified hot gas steering control systems: a reaction control system for outer space flight stabilization and a hot gas actuator control system for terrestrial steering (in the atmosphere and under water).

Both systems eliminate any need for pumps, heat exchangers, solenoid valves and other apparatus required in earlier control systems. And both systems utilize hot gas, operating off either the main engine or a separate fuel source.

The gas in the outer space reaction control system is fed into a set of nozzles which impart spin to the missile to stabilize its flight through space.

In the terrestrial hot gas actuator control system the gas is fed into an on-off controlled linear actuator which moves the fins controlling the missile's attitude in the atmosphere or under water. This system also utilizes a concept developed from the AiResearch hydraulic "potted circuit." This approach eliminates complicated plumbing, thereby decreasing the weight and increasing the reliability of the system.

AiResearch is a pioneer, leading developer and manufacturer of hot gas systems and other nonpropulsive power systems for atmospheric, underwater and outer space missions.

Your inquiries are invited.

THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

Los Angeles 61, California • Phoenix, Arizona

Systems, Packages and Components for: AIRCRAFT, MISSILE, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS



thanks to **XEROGRAPHY...**

A Stock-Print System Saves You Up to \$50,000 Yearly

You can save \$50,000 or more a year by installing a stock-print system of engineering drawings. Calside-Hammett Inc. of Milwaukee is achieving such an economy. So is

Arma Division, American Bosch Arma Corporation, Garden City, N. Y.

A stock-print system is a standardized library of engineering drawings ready-made to use. The library is unattended. Anyone who wants a drawing helps himself! There are no requisition forms, no waiting, no re-figuring. Prints are so inexpensive that engineers are eager to discard them after use.

What makes such efficiency... and such saving... *unconceivable*?

The answer is xerography, and offset duplicating. Xerography is a dark, fast, dry, electronic copying process that without waste reproduces original drawings as large as 34" x 44" and, computer-aided, copies are run off on an offset duplicator.

There is a wide range of Xerox® copying equipment for setting up an efficient stock-print system. Your reproduction needs determine the appropriate model best suited to you. All models—besides paper-

less offset paper systems—make copies on plain, textured paper or transparent materials for *double-copy reproduction*.

All models—whether manual or automatic—make, reduce, at very low cost. They offer the fastest, most accurate, most economical way to get sharp, clear copies from original documents of all kinds at from 10¢ per copy.

Make the proof-of-performance test run showing how xerography of all sorts are speeding paperwork duplicating and saving thousands of dollars yearly by xerography. **Haloid Xerox Inc.**, 400-1603 Haloid St., Rochester 5, N. Y. Branch offices in principal U.S. and Canadian cities. Overseas: **Rank-Xerox Ltd.**, London.

**HALOID
XEROX®**



PUSH THE BUTTON and copies flow!



GERMANIA-2 SAUCER-FOUR WP-2 TRACER, early warning aircraft for Army anti-air operations, carries long range radar detection equipment

BENDIX 20 KVA GENERATING SYSTEM PROVES TREMENDOUS VERSATILITY

Here is a lightweight, transportable, AC generating system that brings extreme dependability to its many applications. First developed for the USAF for use in its Convair atom fighters, the Bendix 20 KVA system will soon be flying for the U.S. Navy on Grumman's WF-2 and Sikorsky's HO4S-2.

The Bendix system regulates will provide close voltage regulation and will hold transients to a minimum with rapid recovery. The protection panel

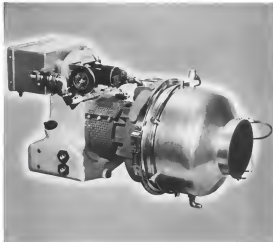
will protect the critical aircraft components from under- and over-voltage and from under- and over-frequencies.

Offers unusual effectiveness on transient and on a wide variety of loads—in fact can be used on any engine-driven, air-driven, hydraulic-driven or pneumatic-driven application—on other airborne or ground. Get further details from BENDIX AVIATION CORPORATION, EASTERN TOWNS, NEW JERSEY.

West Coast Office: 1175 Pershing, Burbank, Calif.
Branch Sales & Service: Bendix International, 200 E. 42nd St., New York 17, N. Y.
Canadian Affiliate: Avionics Bendix Ltd., P. O. Box 4103, Montreal, Quebec.



MOORE JAG 2, designed for long endurance flight and low altitude loitering—can shipboard as well as during take-off and landing operations



Multipurpose APU

*New Solar gas turbine 80 hp APU is only 12½ in.
in diameter x 25 in.—weighs 59 lb*

SOLAR's NEW gas turbine powered multipurpose APU is ideally suited for airborne and ground power applications—to drive hydraulic, electric or pneumatic controls for aircraft stations, fuel pumps and portable generator sets. The Turbo engine has the highest power-to-weight ratio of any powerplant in its class. It is ideal for single or multiple outputs from 25 hp to 80 hp.

The lightweight unit is simple in design, easy to maintain and can be started instantly—without warmup—in temperatures from -60°F to 130°F and under wide atmospheric pressures. It operates efficiently on a variety of fuels.

These gas turbines are setting new standards of performance and reliability in propulsion units for one-man helicopters, in portable electric power

plants and in other applications. For details, write to Dept. 21-135, Solar Aircraft Company, San Diego 15, Calif.



IBM 1620 *data processing system*

...the most powerful engineering computer in its low price class



The new IBM 1620 is a desk-size engineering computer that offers you more computing ability per dollar than any system in its price class.

Transistorized throughout, the IBM 1620 has a 10,000-digit magnetic core memory with variable field length and immediate accessibility. Its input/output notation, on paper tape and console typewriter, is in convenient decimal arithmetic. It can perform more than 100,000 calculations a minute and is easily adapted to your engineering problems.

Easy to learn, easy to operate, easy to communicate with, the low-cost 1620 helps free your engineering talent for more creative work. And in keeping with our concept of Balanced Data Processing, the IBM 1620 is supported by extensive services. This includes a comprehensive library of mathematical routines and specific industry programs to permit you to put the 1620 to work without unnecessary delay.

Ask your IBM representative about the unique advantages of the IBM 1620. Like all IBM equipment, it may be purchased or leased.

balanced data processing **IBM**

Announcement



CRYOGENIC
EQUIPMENT
FOR
MISSILES
AND
ROCKETS

Stevens-Cambridge, under license from National Research Corporation, is now using the newly-developed super-insulation NRC-2 in its equipment for storing and transporting such hard-to-handle cryogenic fluids as liquid helium and liquid hydrogen. NRC-2 is a multiple barrier reflective insulation operating under high vacuum. Tests by National Research Corporation and university laboratories at the Stevens facility at Los Angeles, December 19, 1960 and Lowell, Massachusetts have established its thermal efficiency.

REDUCES HEAT LOSSES

NRC-2, when compared with equal thicknesses of 80-watt per inch, allows only 1/257th as much heat leak. Performance records show NRC-2 to have the lowest heat transfer coefficient of any cryogenic insulation now known. Tests show up to 28 inches heat per inch between room (ambient) temperature and liquid nitrogen (161.5×10^{-3} BTU/hr./sq. ft./°F) have been produced.

WEIGHT AND SPACE SAVINGS

NRC-2 weighs 71.5% less by volume than perfluoropolymer and is easily mounted and ungirted. It moves in small increments over the critical features of the reduced insulator insulation space required.

Through its high efficiency, NRC-2 cryogenic insulation also eliminates the need for a costly protective jacket of nitrogen. The latter alone could add a considerable savings on operation and maintenance in storage equipment.

COMPLETE CRYOGENICS LINE

Stevens-Cambridge now can provide NRC-2 insulation on its complete line of cryogenic equipment for the transportation and storage of ultra-low temperature liquefied gases. Contact the Stevens plant near you for complete information.

**STANDARD
CAMBRIDGE**



25-TON STORAGE VESSEL



400-GALLON TRAILER



ALUMINUM HYDROGEN TANK



500 GPM PUMPING SYSTEM

STANDARD Cambridge Equipment is serving such projects as Outer Space, Rockets and Tunnels.

STANDARD STEEL CORPORATION
CAMBRIDGE DIVISION

500 Boyle Avenue, Los Angeles 58, California • Letter Box 9100, Chalfont, Delaware 19 • Cambridge Division, Lowell 99, Massachusetts



The strength and depth of the nation's defense capabilities depend directly on the caliber of the personnel of the Air Force Ballistic Missile Program and require advanced space programs.

In fact, the Air Force is dependent on the technology from all land, sea, and air services. All of these agencies are now a part of a knowledge base that will be drawn upon for space capability and tomorrow's defense.



In building strength upon strength in the new space technology leadership, the knowledge and experience gained from Atlas, Titan, and Thor ballistic missile systems development is being applied to advanced Minuteman. For these programs, under the management of the Air Force Ballistic Missile Division, Space Technology Laboratories has had the direct responsibility for over 40 systems engineering and technical programs.

As these ballistic missile and related space programs go forward, STL continues to maintain its technical leadership and scientific excellence.

In this capacity STL offers unusual opportunities for growth and work in the science and technology of space systems. To those scientists and engineers with capabilities in propulsion, electronics, thermodynamics, aerodynamics, structures, aerodynamics, computer technology and other related fields and disciplines, STL now offers immediate opportunities. Please address your inquiries and/or resumes to:

SPACE TECHNOLOGY LABORATORIES, INC.
P.O. Box 9006, Los Angeles 46, California

Los Angeles • Santa Monica • Cape Canaveral • Washington, D.C.
Manchester, England • Bangalore • Bombay

Building
Strength
Upon
Strength...
the
USAF
Ballistic
Missile
Program



EDITORIAL

An Excellent Report

The House Defense Appropriations Subcommittee has done an excellent job in acting on the problems posed by the Fiscal 1961 Defense Department budget. Rep. George Mahon (D-Tex.), chairman of this subcommittee and a veteran of many years of distinguished congressional service as defense policy, and his constituent members from both sides of the aisle deserve a hearty salute of thanks from the American people for the conscientious and courageous job they have done in this extremely critical year. The Fiscal 1961 defense budget is critical not because there is an immediate defense crisis facing the nation today. It is critical because the Fiscal 1961 budget will determine our defense posture in the immediately critical years of 1961-64.

The Appropriations Committee, in reporting on the bill as amended by Mr. Mahon's group, has made only a slight change in the total defense budget—adding \$123.9 million to a total budget of \$39.3 billion (see page 30). This action suggests the continuation of many errors of the Administration's defense program that major increases in defense appropriations are not the real answer to the defense problems facing the nation in the critical years ahead.

The Real Need

What is really required is a more selective concentration of the money available on the most modern and militarily significant weapon systems and a far better management of the military establishment believed to clear-cut requirements of national strategy in a world of rapid technological change. In answering this problem, Mr. Mahon's House group has done a particularly fine job. We predict the wisdom of the defense position being set now and their recommended allocation of funds toward the most significant weapon systems of the future will enjoy the crossfire of public debate and the acid test of history far better than the original budget submitted by the President last January. This construction, in a commendable bipartisan spirit, has done a far better job than the original Administration budget planners in allocating the defense dollar where it will do the most good.

Few Americans, after studying the testimony of Gen. Thomas S. Power, head of Strategic Air Command, before Congress in recent months will quarrel with the Mahon subcommittee's conclusion that funds must be increased to provide for the long lead-time procurement of space necessary to develop an airborne alert capability for a significant portion of SAC's B-52 bomber fleet and its supporting jet tanker complement. The committee's recommended increase of \$115 million for this purpose combined with the original Fiscal 1961 budget request of \$65 million and \$175 million obtained from reprogramming earlier budgets and dipping into the war reserve authorization fund, will provide logistic support for a SAC airborne alert capability of a size below the 275-bomber level recommended by Gen. Power. These figures do not provide for acquisition or training of any addi-

tional air or ground crews required for the accelerated operations of the airborne alert. It must be obvious to the committee that a mechanical capability unsupported by sufficient trained flight and maintenance crews offers little increase in real combat capability. It is pending as to why the stepped short of the full solution after such a necessary start. Other action may lie in the renewal of the President's authority to incur a deficiency in Defense Department funds any time he deems it necessary to maintain an airborne alert for SAC. However, with the 10-12 month lead-time required for training bomber and tanker crews and jet electronic and engine maintenance personnel, this authority may cost for little if a crisis occurs soon or swiftly.

The committee's action in providing funds to accelerate development of the key systems, Atlas and Saturn reconnaissance satellite systems appear very worthy sound. It is difficult to understand the technical soundness at the top levels of the Pentagon that have combined with constant reorganization to artificially retard these vital programs. These reconnaissance systems offer great promise to decrease our vulnerability to an enemy's surprise attack with ballistic missiles. The technical state of the art in this area is far more advanced now than was the KGBM technology when national top priority was accorded to push the Atlas and Titan programs. If our sound national policy to use space for peaceful purposes has any validity, these programs should be pushed as hard as possible. For, although they will be military-operated systems, they offer a major advance in our ability to prevent any aggressor from waging successful war.

Procurement Process

The Mahon subcommittee report also has some interesting, and we think valid, comments on the military procurement process and the system of budget ceiling control that has come to be the primary control method in operating the Defense Department fiscal machinery. There is little doubt but that this budget ceiling approach to formulating the defense budget often inhibits the providing truly effective defense budgets adequate to cope with the pace of modern technology.

A detailed study of the Mahon subcommittee's observations and analysis of these points, as contained in its report to the House will be rewarding to American citizens who have been puzzling over the more apparent contradictions arising from the fact that we are spending about \$60 billion annually on national defense and are still not meeting the technical challenge of the future or that of our most vigorous competition.

In fact, every serious student of the defense problem and every American who is interested in the future survival of his country and its political philosophy should read and study this report carefully. It is a major contribution to the national debate on the adequacy of our planning for defense in the critical period looking on the immediate horizon. —Robert Hutz



HOW THE SILICONES MAN HELPED...

CUT SILICONE RUBBER INVENTORIES AND SPEED DELIVERIES

Until recently, the rubber fabricator had just two methods of obtaining silicone rubber compounds expressly suitable for specific products. He might purchase pure stock and formulate his own compounds, or he could buy a variety of standard stocks with properties as close as possible to his requirements.

Now every fabricator can readily achieve the rubber compound he last stated to the goods he produces. The new method is a complete answer. It consists, first, of a basic UNION CARBIDE silicone rubber compound, or "masterbatch," and second, of masterbatch data that permits any fabricator to mix and mix ingredients to meet his needs perfectly.

Benefits: Inventories are reduced. Deliveries are

made faster. The least expensive ingredients for the job are always employed. Extensive technical studies and test-and-retest are obviated. There's strict control and accurate estimating of compound costs, invaluable in a highly competitive market.

This unique method is another of the many ways the UNION CARBIDE Silicones Man is helping rubber fabricators. Sound interesting? Please write for details to Dept. RA-8004, Silicones Division, Union Carbide Corporation, 30 East 43rd Street, New York 17, N.Y.



SILICONES

The term "Silicones Carbide" is a registered trade mark of UCO. UCO is a registered trademark of Union Carbide Corporation. Division of Union Carbide Corporation, New York 17, N.Y.

Single Management For Rover

Watch for Harold B. Fieger to be named manager of a joint NASA-AEC effort to run Project Rover. Single management approach will replace the current system of coordinating separate NASA and AEC efforts in the nuclear rocket development program. Fieger currently is NASA's reactor program director.

NASA held a bidder's conference last week on a study contract to define the Rover flight test program. Study will evaluate the vehicles, support equipment and techniques involved. Conference was attended by 10 companies.

Air Force is seeking congressional support for a plan to join Thiessplan Research and Development Corporation for facilities taken from Space Technology Laboratories as a nucleus for the proposed new USAF nonprofit organization. Rep. Carl Vinson reports that USAF Secretary Dudley Sharp told him the Air Force has the authority to make such a deal. Sharp estimated it would cost \$40 million a year to operate the nonprofit corporation, a new group which is to take over the STI. Federal management functions in nuclear and space programs.

General Accounting Office is investigating the proposal. Enthusiasm of the plan is expected to be included in the GAO report on USAF nuclear missile program management, which is to go to Congress shortly.

Tighter Procurement Policy

Congress is pressing the Pentagon to tighten procurement policies in the wake of a stream of General Accounting Office reports citing excessive military contract costs.

House cut \$400 million from Fiscal 1963 military procurement budget last week to form the issue. Appropriations Committee cited "identifiable waste" proposed the cut to control "padding of military orders." The group also said military contracting officers will be called to explain their actions in administering "cost-plus" contracts.

House Armed Services Committee has launched an attack on incentive contracts used by Air Force and Navy to attract and motivate procurement. House group, led by Rep. Carl Vinson, mentions this type of contract permits contractor workloads. Key witness supporting committee position at hearings last week was Representative Board Chairman Thomas C. Gagliardi.

Senate Small Business Committee spotlighted a GAO claim that Convair spent too much for B-45 air conditioning units. GAO says Convair's B-45s spent \$2.6 million unnecessarily in buying special equipment designed and developed at Convair's San Diego plant instead of adapting existing equipment.

Borrowing 'Fees'

Sen. Harry F. Byrd, Finance Committee chairman, attacked the Defense Dept. report last week for allowing "loans" to cover contractor borrowing costs. Fees are a loophole to get around the fact that interest on loans isn't an allowable contract cost. Practice was begun after Defense reacted to panel financing of contracts in late 1957 to cover other orders. Contractors had to borrow to finance their military work.

Look for a strong effort in the Senate to return the B-70 to a full weapon system development program. House Appropriations Committee opposed the Administration approach to building two prototypes at a cost of \$1.5 billion. Support for an experimental program is expected from members of the Senate Armed Services and Appropriations Committees as well as from other individual senators.

Chief Air Marshal E. A. Verhagen, commandant-in-chief of the Soviet air force, and one of his top aides have accepted invitations to visit the U. S. this week, returning the 1955 visit to Russia by Gen. Nathan F. Twining, then USAF chief of staff, from point later.

Inspection was extended only two months ago when, according to a Defense Department spokesman, "it was deemed appropriate in view of the increasing exchange of visits by Russian and American officials." Verhagen's group will visit the Armed Forces Day air show at Andrews AFB near Washington on May 14 and 15.

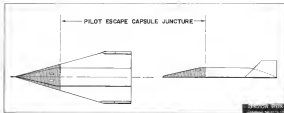
Soviet Missile Accuracy

Adm. H. D. Felt, U. S. commander in the Pacific area, says Soviet ballistic missiles are accurate in nearly all U. S. weapons. He told the House Military Appropriations Subcommittee that recent reports the Russians say their own Pacific fleet and their accuracy "was as good as we get." Adm. Felt noted the Soviet missile is bigger than U. S. missiles and "very guidance system is probably simpler and very, very good."

Senate and House space committees are watching activities of NASA's new Office of Life Sciences closely. They want to make sure NASA keeps its promise not to duplicate existing civilian, aerospace medical facilities.

House Committee on Science and Astronautics will hold hearings next week on aerospace transport development problems and status of related research. Committee will hear witnesses from NASA, FAA, CAB, Air Force, airlines and aircraft industry.

—Washington Staff



MAIMED ROOST GLIDE configuration chosen for Dyna-Soar is similar to the winged, fat-bottomed shape shown above.

Dyna-Soar Flight Test Schedule Detailed

First air drop from B-52 planned for fall of 1963;
initial manned glider launch slated for early 1965.

Washington—Development of the Dyna-Soar manned glide glider, the subject of Air Force and military studies since 1954, is finally moving into a testable state only for

- First air drop of a Boeing glider from beneath a B-52 was scheduled for the fall of 1963. Dyna-Soar will replace manned glider flight.
- First launching of an unmanned glider by means of a modified Minuteman missile booster from 29 or 30 ft at Cape Canaveral Fla. in early 1964.
- First launch of a manned glider by itself in early 1965.

Next step in the Dyna-Soar program is to define precisely the subsystems of the glider and launcher, prepare detailed design and performance specifications and hold competition for subsystem contractors.

For the glider, this will be done by Boeing with the Dyna-Soar Weapon System Project Office supervision. Contractors are expected to be awarded in the early fall, but it has not yet been decided whether subcontracts would be awarded to contractors working directly under Air Force supervision or subcontracting to Boeing.

The subcontract arrangement, to be used by Boeing, now seems more likely, but USAF's strong determination to return the minimum mission side (AWW Nav 16) is still an issue that the executive structure will be chosen.

Although competition will be the rule in selection of subsystems makers, Air Force says that a sole source will be accepted if the glider contractor can justify the procedure. Initiatives will

be very difficult, however, and a sole source will be the minimum.

Present schedule calls for completion of a glider contract by early 1961 and release of 90% of the drawings by the spring of 1962. The first mission or drop follow by some 15 months. Decision to go ahead with Phase I of the program, which will cover development through the noncritical flight, came after a special selection review under Phase Alpha (AWW Nav 28, p. 71). Phase Alpha was selected over the previous draft of actual development for two main reasons:

- To get firm proposals of a number of different ideas in a month that was to be used as a basis for a final decision in a modified North American X-15 instead of an all-new vehicle. This review-to-choose that the best approach was being used was selected by the then Assistant Secretary for Research and Development Joseph W. Church.
- To develop a truly definite plan for making each of the expected performance-related, multi-use, testing, etc.

Project Alpha produced a stack of reports 15 ft high and concluded that the mated glider should be essentially the same glider configuration that was selected last fall.

The glider will weigh about 10,000 lb., have a wing loading of less than 10 lb./sq. ft., and a lift to drag ratio of between 15 and 2.5, depending on velocity.

In general appearance, it will resemble the glider proposed by Boeing's next test competitor for Dyna-Soar, the Bell X-45A Corp.

While there is no satellite requirement for a Dyna-Soar vehicle at the moment, USAF feels that this glider will meet the general outline of a 30-ton vehicle in size and is now expected. Dyna-Soar is expected to enter very much more thinking or post the way to make realistic estimates of requirements for such a vehicle.

Structure probably will consist of an access shell on the outer surface, a layer of insulation, probably from ceramic, conductive panels, and beneath that a inner structure, according to what is to be used in the actual development for two main reasons:

- To get firm proposals of a number of different ideas in a month that was to be used as a basis for a final decision in a modified North American X-15 instead of an all-new vehicle. This review-to-choose that the best approach was being used was selected by the then Assistant Secretary for Research and Development Joseph W. Church.
- To develop a truly definite plan for making each of the expected performance-related, multi-use, testing, etc.

Project Alpha produced a stack of reports 15 ft high and concluded that the mated glider should be essentially the same glider configuration that was selected last fall.

The glider will weigh about 10,000 lb., have a wing loading of less than 10 lb./sq. ft., and a lift to drag ratio of between 15 and 2.5, depending on velocity.

Under a letter of agreement signed

last Nov. 11 by USAF Chief of Staff Gen. Thomas D. White and NASA Deputy Administrator Hugh L. Dryden, NASA is serving as technical adviser to Air Force, and the program is being run in a research aircraft project. It allows main program work at the X-15 and X-16 as that a support system will evolve directly, instead of in a separate development drawing upon the X-15 craft technology of the program is successful. Except for final aspects, the research vehicle will have special operational performance characteristics.

USAF believes that use of the unpowered glider will allow it to study a wide Mach number range on each flight, and to cover the entire flight spectrum in a few flights. This will avoid the many costly test programs of programming in test velocity increments as approach still favored by a number of NASA technical people. USAF thinks that the maneuvered approach with attempts to take large steps on each flight is the only one it can afford. It has insisted on contractors that the number of test flights must be held to a minimum—11 or 12.

The Alpha review confirmed USAF that it has the best approach to the glider's design within today's capabilities. Even if it is not the best, the one that is desirable was available today, it might be done by the way it is presently planned. Possibilities of the materials, structural approaches, etc. were presented, showing for growth, but the studies increased confidence in the feasibility of the program.

Flight Tests

Flight tests will be supervised by a committee composed of Air Force, High Test Center personnel with NASA Flight Research Center personnel and chaired by a USAF official. Data acquisition, reduction and distribution will be supervised by a similar committee, chaired by an NASA man.

Chosen launch sites for the Air Force Minuteman First Century Cape Canaveral will lead on island vehicles along the Atlantic Missile Range. Facilities will include deep shops, machine shops, tool control systems and automated laboratories are expected to be utilized at General Motors, Island, near 170 and on from the support of Midway Island. 544 sq. mi. of damage, at Mangrove Point Range 946 sq. mi. of damage, at St. Lucia, 1,800 sq. mi. of damage, and at Accra, 1,800 sq. mi. of damage.

When and if Dyna-Soar proceeds to Phase II, which will call for robot flights, this could be based from Cape Canaveral by an improved Titan or possibly an improved Atlas and would lead to the X-15 and X-16. If a winged vehicle follows it will be based by the Saturn vehicle.

Major Reorganization Designed To Broaden WADD Capabilities

By Philip J. Kline

Defense-Doar reorganization of Wright Air Development Division designed to reverse its capabilities for performance, engineering and integration of complex systems within a new order of hierarchy.

Major thrust of the reorganization is the division of the laboratory into two separate groups, one to conduct advanced state-of-the-art development, the other to provide system engineering support to Weapons System Project Office (WSPO).

The reorganization is the most far-reaching in the history of the Air Force facility since. During the next several weeks, about 1,000 personnel will be moved out of the total complement in WADD, will be shifted to new buildings and offices.

New Plan

Under the new plan, WADD now consists of three major directorates plus four supporting groups.

- **System Management**, under Brig. Gen. Joseph R. Holsapple, will incorporate Weapons System Project Office as the parent office which handles work for the Air Research and Development Command headquarters (Systems Management). Directorates under Holsapple will be:
- **Structural Engineering**, headed by Col. F. J. Johnson, is the new organization formed to provide technical support for the Systems Management Directorate.

New WADD Philosophy

Defense-Wright Air Development Division plans to perform most of the system engineering and integration functions which it previously directed to contractors under the original weapon system development contract, according to Brig. Gen. Joseph R. Holsapple, WADD director of system management. Gen. Holsapple told the recent National Association of Electronics Contractors.

His plan is to increase the active participation of the WSPO in the integration of the system system elements through its specific contract structure. The trade group contractors will be used as the D-15 program if 100 programs and some others, a probably group to be modified somewhat in the future, previously new that reflect number of systems allow us to do more work under the Air Force.

Formed for the first new directorate will move largely from contractors and will be the last laboratory which conducted the old directorate of laboratories of the Wright Air Development Center.

Advanced Systems Technology, headed by Col. A. L. Wilson, will consist of five divisions, each containing four laboratories, which will devote their efforts to applied research and state-of-the-art development. Functions to be advanced including, for example, systems limited to develop models.

The Directorate of Advanced Systems Technology, is expected to be the largest of the three, with approximately 2,100 personnel, divided up by the Directorate of Systems Engineering, with about 1,800. Directorate of Systems Management is expected to employ about 700.

The Directorate of Systems Management and Systems Engineering have been established with parallel structures, reflecting the fact that the two will be complementary organizations. In most cases, it is expected that personnel from the two directorates working on the same project will share the same or adjacent offices. The Systems Management Directorate will have "Super-WADD" in the North America Area, which is headed by Brig. Gen. Joseph R. Holsapple, and the Directorate of Systems Management will have "Super-WADD" in the North America Area, which is headed by Brig. Gen. Joseph R. Holsapple.

In addition, there will be five other divisions included in the Systems Engineering Directorate:

- **General Support Equipment**
- **Operational Support Division**
- **Systems Dynamic Analysis Division**
- **Engineering Standards Division**
- **Model & Electronic Engineering Support Division**
- The Directorate of Advanced Systems Technology will consist of:
- **Avionics Division**
- **Aerodynamics Division**
- **Materials Control**



MINUTEMAN TEST VEHICLE loaded on its transporter vehicle is on the way to Edwards AFB, Calif. for one of its seven successful side test flights. Because of development program progress, in which basic configuration of the missile has been determined, launch of the eighth vehicle this month will conclude the test series, which originally called for 14 flights. Initial operations capability is scheduled for 1962. Contractors include Boeing Aerospace Co. for assembly and test, Autonetics Division of North American Aviation for guidance. Thiokol Chemical Corp. built stage propellant and Aerojet-General second and third stage propellant.

Minuteman Ready for Rail Mobility Tests

HYLON TETNER watches flight of delicate Minuteman side test vehicle.



Los Angeles, Calif.—Mobile Minuteman unaccompanied ballistic missile enroute will begin its on-edge tests this month using existing railroad rolling stock owned by the Department of Defense and maintained by the Army's Transportation Corps.

Six different displacements of the test train, comprising approximately 14 cars including locomotive and coaches are planned for this summer and fall each displacing different in the control procedures and tactics to be tested. Data will be collected concerning the effects of varied geographical conditions such as direct sun operations in the summer and through heavily wooded railroad areas in all types of weather, day and night.

Initial three displacements will be operated in the West and Northwest sections of the country and the final three displacements in the Midwest area around Des Moines, Iowa. Each trip will last seven to 14 days, with several days interval between trips to permit analysis of the different factors under study.

Tactics to be tested include random movement between sidings scheduled in advance of the trip and also timing movement of the train to specific sidings over the least suitable package under time limitations.

Strategic Air Command will function as test sponsor of the train, which is primarily to be an evaluation of command control and communication, not missiles. A SAC task force and control center was activated last week at Hill



AFB, Glides Unit, to monitor the command's portions of the program and maintain control over the train during its travels. Task force is commanded by Col. Virgil M. Clark, Jr., who has been director of operations for SAC's First Missile Division, Vandenberg AFB, Calif.

Other agencies concerned with the Minuteman mobility study:

- **USAF Ballistic Missile Division** will serve as test director and will be responsible for technical and scientific aspects connected with the program.

- **Air Materiel Command**, being the Glides Air Materiel Area, will furnish logistical support for the train and its military crew and for additional personnel assigned to Glides for the duration of the test.

- **Boeing Aerospace Co.**, aircraft manufacturer in the Minneapolis, has responsibility for installing instrumentation and USAF-owned single-orchestra and UHF radios in the command and control car. This radio gear, plus the communications system of each of the participating railroads, will permit the main control center at Hill AFB and SAC headquarters, Omaha, Neb., to maintain continuous control.

- **Army of America** Railroads and participating members will furnish locomotives, coaches and railroad crews. Association representatives and individual railroad supervisors will be aboard for liaison. The association also will provide a dispatching apparatus on

IMPROVED NOSE CONE (above) is used for ballist in side tests. First coaches launched in the series had dummy upper stages approximating size and weight of Minuteman. Later vehicles carried flight upper stages with inert propellant. Army Corp. is contractor for the country vehicle. Minuteman test side for flights at Edwards is shown below. Racing time of the solid propellant first stage is limited to a few seconds in these flights.



Pioneer V Provides New Scientific Data

By Craig Lewis

Washington—Pioneer V is continuing to illuminate data from space in early studies of its landmark probe; new scientific insight into the magnetic and rotation patterns between the earth and Venus orbits.

Coupled with data from Explorer satellites and measurements made on earth and from balloons, Pioneer V data is providing comparisons of rotation effects near the earth and in space during quiet days and during periods of intense solar activity. Magnetometer data shows evidence of a steady magnetic field in space and a large, variable ring current flowing westward around the earth at a distance of about 30 earth radii.

Acoustic signal detectors carried by Pioneer V to measure collisions with

micrometeorites has shown wide variations in impact patterns. Discerning early results from Pioneer V, Mission Director, in charge of the Army Research and the National Aeronautics and Space Administration's Office of Space Flight Programs, said that the reliability of the data from this experiment is in serious question because of the probability that the experiment has not reacted properly.

Pioneer V will pass the 9-million-mile mark late this week, at a point very far from earth along an orbital path that has taken the earth and Venus orbits. Adolph K. Thiel, Space Technology Laboratories director of experimental space projects, reports that information data on period performance indicates temperatures and other conditions are within acceptable limits.

Ground stations have taped some times 100 hr of information from the

probe. At it has moved away from earth, signals from its five solar wind sensors have become stronger. Although the receiving station at Haverhill will have continued capability on the five watt unit out to 20-25 million mi., signals levels of in response already are too weak to use.

The 150 ft. (45 m) radio telescope at Manchester, England, is still able to receive data, but it will have to overcome a contention to the 150 watt transmitter within a week, as when the probe is approximately 10 million mi. from earth. This also will bring the Haverhill station back into the receiving schedule. This transmitter is expected to be still transmitting usable data on a 40 million mi. distance when the probe passes close to the Venus orbit on Aug. 18.

Hydro-magnetic Ring Current

Data from the search coil magnetometer on Pioneer V provides the first observation of the hydro-magnetic ring current long described in theory by geophysicists. It indicates disturbances made from Explorer VI data. This ring current is centered at about 18 earth radii and covers the area from about 7 to 35 earth radii—outside the two Van Allen radiation belts. Total current flowing indicated in this smaller ring is estimated at 1 million amperes.

Magnetometer data also indicates that, at least at times, the earth's magnetic field extends out to the 14 earth radii. This is considerably farther than the in-outer circle radii generally assumed for the field.

In interplanetary space, Pioneer V has produced evidence of a steady field that makes a large angle with the plane of the earth's orbit. Disturbances in the quiet-day pattern are being correlated with cosmic ray experiments, particularly those conducted during solar storms to determine their relationship. Dr. Charles P. Sauer, director of the Space Program Section in STL's Research and Development Division, said the evidence "is strong enough to question whether magnetic storms on the earth, the classical type of magnetic storm comes at exactly the same time that there has been a solar flare."

Solar Flare Study

Series of solar flares that began late in March has produced comparison of effects in space with those near the earth. According to Dr. John A. Simpson, of the University of Chicago, a large flare apparently burst a burst of plasma toward the earth on May 10 which reached Pioneer V and the earth only the following day. This produced

DATE	DISTANCE FROM EARTH (IN MILLION MILES)	DISTANCE FROM SUN (IN MILLION MILES)	DISTANCE IN ORBIT (IN MILLION MILES)	COMMUNICATION TRANSMIT TIME
APR 4	3.5	91.0	44	376 SEC
APR 28	6.5	88.5	81	1 MIN 100 SEC
MAY 2	7.1	88.0	85	1 MIN 104 SEC
MAY 16	9.6	86.8	117	1 MIN 41 SEC
JUNE 25	21.5	79.1	119	3 MIN 242 SEC
JULY 23	27.7	75.2	239	6 MIN 470 SEC
AUG 10	48.0	70.9	258	8 MIN 150 SEC
AUG 18	65.8	70.0	316	11 MIN 460 SEC
OCT 23	81.2	69.7	303	14 MIN 340 SEC
DEC 2	86.5	67.7	451	15 MIN 320 SEC

TRANSIT time of landmarks from Pioneer V crosses in the probe some way from earth

a typical magnetic storm. The University of Chicago instrument package in the probe, which measures proton wave changes higher than 71 meV and electrons with energies higher than 13 meV, recorded a sharp decrease in electron wave intensity, known as the Forbush decrease.

Comparisons Cited

Comparisons of Explorer VI and Pioneer V results with measurements taken on earth proved that this decrease does not depend upon the existence of the earth's electromagnetic works, according to Dr. Simpson. He said the data "tells us directly that we are then dealing with a plasma medium from the sun. It provides us with some of the strongest experimental evidence we have to date for the existence of this type of medium."

Another large solar flare occurred on Apr. 1, and solar protons arrived in the vicinity of Pioneer V and the earth about 28 hours later. At the same time, there was evidence that electrons also arrived, providing the first evidence that electrons from the sun travel to earth fairly quickly. Simpson said this clear evidence indicates that the ion acceleration electrons "occurs at the same time as the acceleration of the accelerated electrons."

Radiation Measured

Insulation chamber and Geiger-Müller tube designed for Pioneer V in the University of Minnesota School of Physics, like the Chicago experiment was similar to equipment carried in Explorer VI. Minnesota is prepared to receive to lower catches than the Chicago equipment. Early in the flight, the Minnesota instruments measured radiation in the Van Allen belt, then intensity dropped off substantially to the level of planetary cosmic radiation in space. This level continued fairly steady until the period of solar activity.

Self-produced particles were no-

two weeks preceding Mar. 31. During the magnetic storm that day, the counting rate dropped to 10 per cent and stayed low for several hours. Then, the rate built up to 1,500 per cent over the following week before it began to decay.

A similar counter with a slightly lower energy sensitivity in Pioneer V recorded some small fluctuations of similar electrons in space and Dr. Brown emphasized that Pioneer V detected the incoming plasma cloud, but with very low efficiency. He suggested that, when put at this plasma entered the earth's magnetosphere, the electrons were disrupted and changed their rotation, lowering the counting rate. Then, it is assumed that the sharp increase in the counting rate was produced by some process of acceleration of the trapped particles from the plasma which the Van Allen belt which increased their energy enough to make them detectable.

Outer Radiation Belt

This question leads to the conclusion that the earth's outer radiation belt is not produced by injection of particles from the sun itself, but by some local process of acceleration after the material is trapped in the magnetic field.

Explorer VII measured solar proton counting rates in much as 18 hours the normal cosmic ray rate in the highest latitudes covered by the satellite on Apr. 1 when these protons were being measured by Pioneer V. Explorer VII also detected the Forbush decrease in cosmic cosmic ray counts by Pioneer on Mar. 31. These count rates were measured only when the trapped solar protons in a very low field, as it was at that time.

Fairchild-Umbagh U-18 Nears Flight

New York—First of five prototype U-18 ultrasonic Fairchild X-ray and Analyzer Corp. is manufacturing for Umbagh Aircraft Corp. was made at first flight this week.

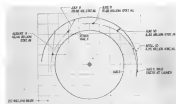
The remaining four prototypes are expected to be completed 1-15 months thereafter, according to signs changes are suggested as those. The five prototypes will be used for certification and testing.

Production testing will be about 30-40% complete when the first prototype is built out. Fairchild has received about \$100,000 from Umbagh for work performed to date on the prototype design and production testing, according to William L. London, Fairchild vice president. Design and production testing was subcontracted to Fairchild by Umbagh under an agreement signed in Decora. A contract was signed in August (AW Aug. 24 p. 13) by both Umbagh and Fairchild for production of 10,000 U-18s.

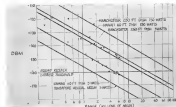
Initiation of production depends on how the certification program goes out, London said.

Umbagh is responsible for financing the U-18 and for the design, performance engineering and sales of the ultrasonic, which Umbagh says it will sell for \$9,995. Fairchild is responsible solely for manufacturing. Umbagh provides personnel, test facilities, the 305 hp Lycoming propeller, battery, which, tires, tanks and some materials.

Umbagh has no stock prototype which has not been constructed. The prototype takes off at about 70 mph, London said, but specifications for the U-18 Fairchild has subcontracted to build off for practically as much as



PIONEER V is following a trajectory that will carry it close to Venus' orbit in August.



SIGNAL STRENGTH is indicated as a function of distance from Pioneer V transmitters.



NIKE ZEUS missile shows two sets of small fins which replace former war tail length, upper staging fins. Configuration is believed to be the final one for the Army anti-aircraft missile. Zeus may be operational in two years, rather than six years as estimated earlier.

Army Changes Nike Zeus Configuration

By Michael Taylor

Ft. Monmouth, Ga.—Army's Nike Zeus antimissile missile has shed the egg-shaped forward fin that gave it its arrowhead shape and replaced them with two sets of smaller fins, one a round set, the other at the back of the vehicle's motor.

When new configuration is believed to be the final one for the Zeus. The Defense Department still has not given the go-ahead to production of the missile, which normally completed successful prototype and engine tests at White Sands, N. M., missile range.

At the same time, Army and industry are conducting preproduction planning programs on the Zeus so that production of tactical systems can begin as

soon as authorized. High-ranking Pentagon officers and civilian industry officials (other than Zeus manufacturers, Avco-Armco) have learned, now believe the Nike Zeus could be operational in two years, not five to seven as estimated earlier.

Woolen mockup of the Zeus in its new configuration was publicly displayed here along with other new Army weapons—some still in the development stage—during Army's three-day Project MAN (Modern Army Needs) conference which ran attended by more than 600 top industry and military leaders, congressmen and representatives of the press. President Eisenhower, Secretary of Defense Thomas Gates, Jr., and Secretary of the Army Walter Bede Smith were present.

Project MAN, an status display and live firing and exercises demonstrated Army's latest capabilities in firepower, mobility and communications. The "needs," shown more by implication than by equation, are for greater capabilities in these three areas than Army now has.

The significance which Army officials laid in net at all during the conference were missile protection and target acquisition. Both these areas are critical, a high Army officer told Avco-Armco, particularly the ability to keep the lethal intercept from a nuclear vehicle from penetrating a weapon such as tanks and personnel centers.

Seamless Stream

Another important need—that is, continuity in weapon system development and production—was stressed by Bede Smith. He called upon industry to develop greater uniformity in drawing up its own contracts for the development of new ideas in weapons and equipment. The Army does not have the money to produce everything that might be "new to have," he said. "In industry must not allow the change in profits to narrow guide influence in its plans and activities from the desire to serve the nation faithfully and well, the veterans added.

On the other side of the ledger, one Pentagon official pointed out, the United States may be employing its work on the development of countermeasures for nuclear-armed but late missiles—that is, on the development of evasive, self and firing mechanisms that cannot be prearranged, triggered by the enemy. This is a problem the enemy should be most concerned about.

High points of the display here, besides the Zeus, were the Pershing missile and the Dory Cassell weapon system. For the first time, the Army

put its new Pershing hypersonic missile launcher, manufactured by Thiessen-Ross Woodbury Corp., on public display. Still new enough to be unusual is its mobile launcher (most of the recent war, besides its addition) the Pershing transporter is a small tracked vehicle.

For contrast of the Pershing, a small missile base plan is laid placed on the ground. Three stabilizing jacks on the small wheels, leveling stand on the ground and at the rear of the stand, and the missile is raised to a 45 deg. of the vertical. At this point, a small motor takes over and elevates the missile to the vertical slowly to prevent oscillations. In three jacks automatically level the small base is level for the Pershing.

An electronic interlock system governs the missile from being moved until the base is perfectly level. The entire operation is less complex than that for the Army's new Sergeant missile and there was some speculation here that the Pershing will eventually replace the Sergeant, which was lost for advantages of being ready for use while the Pershing is still in development.

While the Army is pleased with its Pershing, Lt. Gen. Arthur Tamm, chief of Army Research and Development pointed out that Army has no weapon to cover ranges beyond that of the Pershing (estimated range is 20 to 475 mi.). The Russians, he said, have an entire family of weapons. The Army would prefer the same thing and

toward this end, it is making its A, B and C missile launchers in the last of series which will have complementary ranges.

David Goodrich has said nuclear weapon system for use of those ranges was shown without an accident, in a light, maneuverable and heavy gun-mounted version. Developed by Avco-Armco Corp., the David Goodrich are for use on land as well as in the air. It is a missile that is also shown by General Goodrich. The shoulder-fired Reddy, anti-aircraft missile was the duplicate. Manufactured in Coeur d'Alene Division of General Dynamics the missile is about 4 ft long approximately 1 in. in diameter and weighs about 30 lb. Launcher tube for the Reddy also serves as its shipping container.

Two other missiles, the non-nuclearized Nord SS-10 and SS-11 interceptors, were shown in two flights. The SS-10 is a two-stage solid propellant missile with a range of 480 to 1,700 yd. It carries a 105 mm. warhead and is fired in a plane of attack from the back of a one-quarter ton truck. It would intercept. It has been accepted by U. S. Army.

The somewhat larger SS-11 is still under test. It has an effective range of from 550 to 1,700 yd. In the demonstration here, it was fired from a Bell 107 (A) helicopter on the ground, hovering and in flight. Both the SS-10 and SS-11 (in all three flights) seemed direct hits.

In other demonstrations, the Army fired Little John and Honest John rockets. The sons of its successful fathers and showed off its various belt capacities in a wide variety of applications.

One of the most interesting uses of the helicopter was made by the Army experimental unit, the Airborne Vehicle and Vehicle Company. Local members of this group is to obtain information on enemy locations. A two-helicopter team from among Bell 107 helicopters flying low and following the terrain for maximum protection, moved in to drop incendiary fire. Once they dropped the incendiary, they then dropped a parachute ball and then one aluminum ball. The incendiary ball is supposed to ignite fire with two 150-lb. incendiary gas munitions on the H-11 and to make observations.

Then, then activities in a general position and reported to the platoon leader. Later, the secret H-11 helicopter was used to cover the landing operation and withdrawal of a rifle squad moving out general positions.

The rifle squad was brought in and taken out by a Shrike B-34 team part helicopter which was also armed and was used as an additional source of covering firing for the rifle squad.



PERSHING transporter-tracker launcher is shown by Thiessen-Ross Woodbury. Entire launching operation is less complex than for Sergeant missile.

UAC Shifts Space

United Aircraft Corp. has abandoned its two-casualty Missile and Space Division and distributed its personnel and functions among other operating divisions of the corporation.

Back of the former Vehicle and Space Division personnel and its two study contracts will be shifted to the Heavy Gun Standard Division headed by Charles M. Keene Jr., who also was elected to a corporate vice president.

Wright-Patterson, former general manager of the Martin and Space Division, who had resigned last year, will continue in UAC as vice president for engineering. Two other division contracts for UAC were also lost last year. From the Martin Aircraft Division, half of 180 Martin and Space Division employees will be transferred to other UAC divisions.



DORY CASSELL close-range missile weapon can be pre-mounted or non-mounted.

Before you ship again... COMPARE

**100 LBS.
BOSTON
TO
CHICAGO**
Including pickup and
delivery for 100 lb. shipment
(see listed below)



Rail express

\$13²⁹



Airfreight

\$12⁹⁵

**100 LBS.
HARTFORD
TO
DETROIT**
Including pick-up and
delivery for 100 lb. shipment
(see listed below)



Rail express

\$11⁹²



Airfreight

\$9⁹⁰

**100 LBS.
NEW YORK
TO
CHICAGO**
Including pick-up and
delivery for 100 lb. shipment
(see listed below)



Rail express

\$12⁶¹



Airfreight

\$12¹⁰

It often costs you less by AIR!

Sample rates for shipments of automobile parts or accessories, electrical or electronic appliances, equipment or parts, machines or machine parts and many other commodities.

Give your shippers the extra speed and service of American Airlines Airfreight at rates often lower than rail express!

American puts at your disposal the world's

largest, fastest airfreighter fleet led by the new DC-7 Airfreighter. American Airfreight offers more direct, one-carrier shipments to more U.S. cities than any other airline. That's why it's the first choice of experienced shippers everywhere.

For full information, contact your American Airfreight office today, or write to, Mr. E. C. Taylor, Vice-President—Cargo, American Airlines, Inc., 101 Park Ave., New York 17, N. Y.

AMERICAN AIRLINES  Airfreight
America's Leading Airline

effices who have in support of the new carrier's latest activities.

Chief targets of the capsule group are Capital President Brent H. Baker and senior vice presidents J. B. Franklin and Walter Johnson. However, other high ranking officers have, hence, some share of the small criticism and both Franklin and Johnson are backed by a number of capsule acquiescents within the association.

Two interim directors, C. Budd Morris, president of Capital until 1947 and James R. Stockton, an adviser to it, in support of the association's program as it was already.

Officers and directors as a group received \$524,957 in salaries and other remuneration in 1959. Last month, in a voluntary action, the group voted to cut their own salaries by 10%.

Employees have been conducting wage reduction plans which would help reduce the company from its present financial dilemma. One only for a 15-month wage differential of 1949 and another proposed the purchase of common stock on a wage deduction plan designed to strengthen the capital base of the company. Whether or not is followed, it is also evident that employees are dissatisfied with operations under the current management and will follow Bailey in most any program he proposes.

A major reason for this loss of confidence in management was a criticism by Bailey in which he said Capital will continue to operate even if it is forced into receivership. Despite growth accepted the challenge and changed that no more, because of the technical nature of its operation, can cause the public properly "under the cloud of bankruptcy or receivership."

Bailey told such a statement would put the carrier at a competitive disadvantage because the usual guidelines for bankruptcy would eliminate potential purchasers to other carriers. He stated that receivers appointed probably would not be people knowledgeable in airline operations and added that the "creditors and debtholders of the company" would be the only ones of decision "exercised to the end of the action, probably "would be gone."

In a direct blast at management, he said the CAB presides in a corner with a bias in favor of the management that management will be "in a strong and able" added that bankruptcy creates the presumption that management is "taking in" one of these areas.

Meanwhile, the Board cut off all charges of Capital being granted an exclusive temporary route to take it over the exact day being. It thereby sets a policy for the Capital case and future similar cases which it said in its mind.

— the Board's policy with regard

to the award of subside on a temporary basis does not outweigh that any, or all, carriers to financial straits shall be awarded subside simply upon filing a petition. "In the original order denying the subside, the Board and then, as a "human question" as to whether Capital would be financially entitled to a subside at all.

Last week, it issued an order, which was based because of Capital's "unusually critical condition" but which sharply criticized Capital's failure to

provide adequate service to Flint and Grand Rapids, Mich. It established a minimum of round-trip flights daily which the airline must operate between the two cities and must operate on the East Coast and in the Midwest and ordered that all first-class flights on this route be served by guaranteed aircraft. Because of the financial straits of Capital's on-time performance, it ordered the carrier to submit monthly statements showing departure times of each flight serving the Michigan points.

American Airlines President Urges Abolishment of Trunkline Subsidy

Los Angeles, Calif.—Sichard, chairman of the Federal Aviation Act, so it may apply to U.S. trunk airlines, should be repealed, American Airlines President C. B. Smith said here last week.

Smith is not a man for the doctrine of "letting the market" he pointed out, but he is a dynamic staff. Smith said that the past legislation, the subside service of the act, the federal government should establish and enforce the policy that it will not pay subside for operations over an specific route, if there are no air routes current in the same route capable of operating adequate service without a subside.

Smith continued that today's route structure, should be reshaped to meet that he called "natural" competition where no chartered opportunity for profit and hope for subsequent line reduction.

Reduction of today's airline routes, he said is a basic cost problem rather than a matter of the Federal Government, to which has been added route after route, often in personal failure over a period of more than 20 years.

This structure needs reorganization to bring it up to date with the times. It is, he added, not a question of reduced unit carrier and the industry itself depends on sound development and a firm substructure on which to build.

Believing the reforms with the character of competition, in spirit of our national savings that the economic integrity of the airlines would be endangered has continued. Economic growth for the last quarter of this year indicates a sharp increase in demand, Smith said. Calculations show that the trunkline industry's gross loss for the first quarter of 1960 will approximate \$14 million compared with a net profit of \$6 million in the same period last year. Smith said that \$10 million, not all of it due to the bad weather during 1959's first quarter.

Smith pointed out that in 1955, American Airlines sold \$4 million worth of air transportation and in 1960, it

expects to sell \$400 million worth. In 1955, American's capital was less than \$1 million, today it is about \$100 million. Its total assets have more than doubled since 1955 but American's earnings have gone up only about 10% in the same period, he noted.

The looking of a significant transport in the past stage of development, a "business decision" the American Airlines chief executive contended, since the decision cannot be made by the shareholders at the surface, or better, become one in less than five years in its nature. Such a project will have to be sponsored by the federal government, he maintained. He believes that it would cost no more to be the leader in introduction of expensive transportation than to catch up at some later date. In fact, he probably would not lead to lead he indicated, provided technical subside are developed in the North American 300 program.

Smith also urged that certain developments in the National Aeronautics and Space Administration which have tended to place governmental subside on a much lower level than in previous years. He said, the government's decision in NASA is not good, he declared, with some of the talented and devoted scientists being transferred to space activities and others leaving to join industry. The latest products of the U.S. aircraft industry demonstrate a lack of knowledge for best designs and their problems highlight the need yet to be explored.

Among the areas and upcoming developments he listed:

- Airframe control and stability—over the total speed and operational margin
- Low-speed takeoff and landing—critical in operational problems
- Materials—strength—weight, strength and fatigue resistance
- Maintenance—including crew air maintenance
- Aerodynamics—including boundary layer control

Another space age development
from BENDIX



Magnified view shows multiple strand wires that make up ribbon wrap.

UNIQUE BENDIX WIRE *RibbonWrap* REDUCES WEIGHT, INCREASES RELIABILITY OF ROCKET CASES

Bendix has licked the problems of weight and reliability in light weight pressure vessels. Result of the Bendix-developed rocket cases: many tiny wires braided strength steel wires formed by adhesive bonding into a highly efficient ribbon. Weight and distribution of the braiding adhesive is precisely controlled. Result—rocket cases with test strength as high as 531,000 psi, equivalent to a hoop stress of 250,000 psi UTS in

a homogeneous case. A specially designed Bendix machine produces the rocket case. The best wrap pattern for each case is automatically determined and precisely controlled. Finished product is a rocket case tape—made for configuration, strength and reliability.

For more complete information, write Rocket Equipment, Bendix Products Division, South Bend, Indiana.

The Bendix wire *RibbonWrap* gives you these important advantages:

- Design Flexibility
- Control Maximum Weight
- Close Tolerances
- High Temperature Strength
- Shortest Prototype or Production Lead Time
- Assessment for Low Cost
- Inherent Reliability

Bendix PRODUCTS DIVISION South Bend, IND.



Jets Boost Chicago Helicopter's Traffic

By Glenn Gordon

Chicago—Blasted by a rapid rise in jet service at O'Hare Field, Chicago Helicopter Airways' traffic is expected to reach a record total of 130,000 passengers this year.

In 1959, its first year of passenger operation, the helicopter carrier's Sales & S&S sales totaled 384,300 passengers, an 87.6% increase over 1958 and a total far beyond CHA's most optimistic estimate (AW June 15, p. 49).

The Chicago airline thrives, handled more passengers than the other two major U.S. scheduled helicopter operators—Los Angeles Airways and New York Airways—handled together. Total for all three was 366,600 passengers.

These were other impressive signs of CHA's booming growth: average passenger miles up 54,150 to 3,687,453; passenger load factor up from 37.8% to 51.7%; air miles flown up 75,755 to 343,532; scheduled routes flown up 37,756 to 810,236. Operating revenues totaled \$3,808,216, a 39% increase. Passenger revenues increased 94% to \$1,213,504, and net income soared 170% to \$233,344 including capital gains.

Jet Factor

Major factor in CHA's growth is the rapid scale jet operations now handled at O'Hare, which has resulted in a rapid shift from last summer's air bus schedules to that airport from Chicago-Milwaukee. These time-consuming jet passengers offer a take-home market for CHA over its route triangle between the airports and between each airport and downtown Chicago.

In the end of 1959, this market total account for 66-65% of CHA's total passenger traffic in the airline's first year of jet service, according to C. E. Little, vice president-traffic and sales. Little told Aviation Week he saw a surge of last August's traffic

finding that 5,600 of the month's total of 10,000 passengers were traveling to or from jet airports. The proportion of jet passengers isn't quite as high as it was, but it is increasing as more jet schedules are added to the airlines serving O'Hare, where all Chicago's jet traffic is handled. About half of last month's 18,000 CHA passengers were jet arrivals or departures, Little estimated.

Recent traffic increase has been on the Chicago-Milwaukee route, segment of CHA's triangle (page 49), which runs through traffic. Inter-airport traffic, however, accounts for about two-thirds of the total.

The helicopter airline's eighth and best \$48-a-fare New York Airways route turned in to Ward and room obtained in Milwaukee monthly word into service and brought the daily trip total over the triangle to 335 as of May 1, an increase of 50 trips. Load factor last month before that addition was running about 53%.

Suburban Service

In addition to the 185 triangle flights CHA operates seven daily-extended schedules to Waukegan, Ill., and to Gary, Ind. Plans to expand this suburban service are being slowed by the big demand on what the airline calls its own "golden triangle" route.

Chicago Helicopter Airways expects delivery in 1960 of four Sikorski HO4 turbine-powered helicopters of a total conditional order of six. These 14-passenger helicopters will greatly increase the airline's jet capacity, and a big objective now is to develop traffic to fill the new capacity, according to C. W. Moore, executive vice president. Along with this goal is that of developing the ability of CHA to compete for more with increased volume, Moore told Aviation Week.

"Actually, we're ahead of the \$ 95-a-Mile and, adding that present helicopter service can be increased with the bigger aircraft. The volume CHA's traffic next year may total 400,000 passengers."

Isairline Traffic

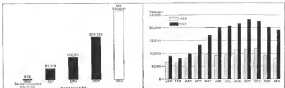
About 95% of the helicopter carrier's business is airfare. In the market now is no agreement between CHA and other jet operators—American, TWA, and Continental—who know the fixed wing carrier will pick up half the 50 helicopter line between Madison and O'Hare. Other airlines are expected to come as later.

More than 90% of CHA tickets are now paid for in other carriers. There is no joint fare except with baggage bag carriers serving Chicago and there represent a small part of CHA's business. The helicopter airline isn't pushing the international unit fare because too hard, Moore said. With traffic levels high as they are, it is an unattractive business to sell a joint fare ticket which involves giving up 50 cents on a \$5 fare.

Chicago Helicopter Airways should be able to come off easily when the fleet of \$ 415 is in operation, according to Moore. Best mile rate is expected to be about half that of the \$ 55. Operating cost not available now even with the present fleet is now about 30 cents. This is a footnote figure and includes the four Bell 47G-3 helicopters operated over CHA's mail routes.

Mail revenues and government payments for developing mail and passenger service totaled \$7,786,726 last year, up from \$1,536,390 in 1958.

Present average rates on tickets is about 35 cents. Moore said. On the triangle routes alone, the \$ 55 operation probably would break even today, but the mail routes, regarded by CHA as highly important, and suburban passen-



GROWTH of Chicago Helicopter Airways' passenger traffic since 1956 is indicated above. The 1959 increase was 87.6%.

Prying saucer!

IN DIAMETERS UP TO 100', Aeronca designs, produces, and tests precision antenna systems for advanced radar complexes.

Postwar new concepts in design and construction, Aeronca parabolic antennas set new standards in precision . . . regardless of size. The principle and accuracy inherent in the 60-foot X-Band dish illustrated above are adaptable to antenna designs of virtually any size or shape.

Aeronca antennas are lightweight high-strength rigid structures of honeycomb or sandwich construction. Developed by advanced design techniques, they are fabricated by advanced techniques that substantially reduce tooling requirements . . . simplify unit design . . . assure low-cost production. In addition, Aeronca antennas permit lighter support structures and mechanisms because they weigh 40% to 60% less than conventional designs.

Whether your antenna problems, Aeronca can supply "package" capabilities to meet your requirements and specifications. For details, write for BULLETIN AB-351.

Research and development
1714 Germantown Road
Middletown, Ohio

Engineers for antenna R&D Engineers with 2000+ space experience. Write to: E. C. Chastain, Inc. Professional Engineers



APR 64. ANTENNA SYSTEM IN-cluded complete design of antenna for advanced radar complex.



APR 64. ANTENNA SYSTEM IN-cluded complete design of antenna for advanced radar complex.

APR 64. ANTENNA SYSTEM IN-cluded complete design of antenna for advanced radar complex.

get service are not as successful.

A problem with the suburban passenger routes is directional imbalance, with big loads into the city in the morning and away from the city in the afternoon.

Subsidy need per passenger is now about \$5, less than many Douglas DC-1 local service operations, Moore said.

The helicopter airline will offer about 650,000 available seat miles this month and fly 154,000 scheduled minutes. Its enthusiastic officials see vast opportunities for further growth in a market which Moore said is expected to include 16 million passengers by 1965 using the two Chicago airports. By 1970, this total is expected to reach 22 million, and even 31% of this market, which is about what the helicopters have been carrying, is a lot of customers.

Jet Sales Test

The helicopter/blast wing jet combination as a two-way street, Moore pointed out, with the ground-to-air jet refueling providing a sales lead for the jet operator. Some airlines have mentioned that service in their advertising. CIA uses another angle as its billboard ads. They are located strategically along the ground route to the airports, where the conspicuity of a jet passenger tied up in traffic may be persuasive to his aviation.

Other factors inspiring well for future business include a new 350,000 terminal building being built by Meigs Field, the Lang point served by CHA, and a new convention hall planned for construction a quarter mile from Meigs. There also are plans for a big new hotel near the field.

In the passenger operation, there were only 20 mechanical delays last year that took a helicopter off a scheduled flight. Utilization of the seven S-16s operating last month was running about 1,400 hr per aircraft per month, figured which-off to which-on, or about 2,100 hr, at times when the rotor was turning during a scheduled operation. Peak attention was needed last September, when the fleet totaled five S-16s, at 1,665 hr as the which-off to which-on hour.

Black, record now is running about 98 mph off to on. In 1966, CHA expects to fly more than a million miles, about 50,000 mi a month of this with the passenger S-16s and 15,000 a month with the mail-carrying S-16s.

CHA's employee productivity has increased from 31.72 tons employed per employee monthly in 1964 to 110.57 tons last year. Total month number about 116, including 55 pilots.

The owner, which pays out \$2 bills to employees every time a round is broken, believes employee morale has been an important factor in its success in growth.

Wheeler Sells Division

Wheeler Airlines, Ltd., Montreal, has sold an Herry Transport Division, sold an 14 multi-engine aircraft, to Nordan, Ltd., Montreal, a subsidiary of Maritime Central Airways. Sale includes at least 14 airlines, not a cash figure.

Number will increase three Douglas DC-4s, two DC-3s, three Caribbe C-46s and three Consolidated FB-1s. The firm will take over Wheeler's scheduled routes—Montreal-Vancouver, White, Hudson Bay—and also New East route.

Wheeler, in business 18 years and the oldest in sector in Canada, gets several million annual from Quebec and with its current 18 multi-engine aircraft—including six Otters, Dorners, Norsons, Stinsons, Ansons and four Cessna 340s—will continue its spray and both operations and sales its heating and flying company. P. H. (Tom) Wheeler remains in product of the new company, which will be Wheeler Airlines (1966 Ltd.), and which will revert to an original hand owners at St. John's, Quebec.

Soviets Push II-16 In Satellite Nations

Moscow-Soviet Union is pushing its campaign to establish the II-16 helicopter transport as the standard passenger aircraft on major routes operated by its satellite nations before winter.

Already delivered in small quantities to East Germany, Czechoslovakia and Communist China, the four-engine transport is set for contract with Bulgaria and Bulgaria's carrier as the "new favorite." Soviet officials claim that "other People's Democracies" also are in line for the II-16.

Russian production of II-16s through the first quarter of 1969 apparently had not reached the point where it could readily furnish airlines countries with the number of aircraft necessary for efficient operations.

Nonetheless, the Soviets continue to push the new airplane. On a recent trip to Iraq, Soviet Deputy Foreign Minister Mikhaylov offered those II-16s to Iraq Airways under terms calling for payment after 12 years at a 5% annual interest rate. Dr. Haidarid was also a contender for the Iraq market with the Cessna 440 turboprop.

The Russian interest II-16s production has taken the II-16s into Africa where it flies. Soviet Republics of Soviet Union have been an official visit to the USSR.

Meanwhile, Russia has expanded operation of the II-16s on routes of its nationwide Aeroflot airline. The aircraft is used to connect Soviet cities between Moscow and Yekaterinburg near the Arctic Circle, covering the 3,600-mile route in slightly over 10 hr. It will soon be placed into service on the USSR's main northern trunk route—Moscow to Nizhny and Tula, the latter for above the Arctic Circle near the mouth of Vostok Siberia's Lena River.

Reduced Fare Ruling Extended by CAB

Washington—Civil Aeronautics Board has decided to continue its suspension of a ruling that would prohibit fare reduction in travel for retirement or vacation periods of an aircraft until July 31.

The Board ruled in October, 1957, that travel by relatives of officers, directors and employees of the defense and services other persons at reduced rates or without charge violated the Federal Aviation Act. The airlines protested to the Board that these practices were at long standing and part of the current military and labor relations situation. The Board then suspended its order until Sept. 1, 1959, and subsequently suspended the ruling until Sept. 1, 1969, and then to April 30, 1970.

Legislation is now pending in Congress to amend the Act permitting sale of free and reduced rate transportation so that the Board has granted the further extension. Congress of persons affected by the Board suspension are:

- * "Members of executive branches of airline directors, officers, employees"
- * "Retired airline directors, officers and employees"
- * "Members of the immediate families of persons injured or killed in aircraft accidents"
- * "Widows and minor children of directors, officers and employees who have died while in the service of the airlines"

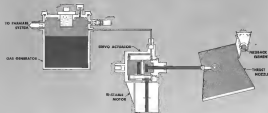
KLM to Test Recorder

KLM Royal Dutch Airlines plans to install an Ampex tape recorder and on one of its Douglas DC-8s before long-term to allow a continuous flight record of a variety of engine and cockpit operating parameters to determine the possible value of such records for maintenance and structural purposes.

After recording, the tape will be automatically analyzed by an IBM 516 computer which can be programmed to seek out unusual operating conditions. Records will record fuel flow, pressure ratio and rpm of each engine, oil and fuel input at the nozzle, air heating, thrust, speed, altitude, engine temperature, and other and some not temporary. Tests will be conducted for KLM by National Institute Laboratories, an aeronautical research institute.



BI-STABLE SYSTEM HIGHLIGHTS CECO HOT GAS DEVELOPMENTS



HOT GAS ACTUATION SYSTEM IN CECO'S BI-STABLE MODE IS

- more accurate
- insensitive to solid fuel contaminants

To position a mechanical load in response to an electrical command with minimum error, CECO has developed solid-fueled hot gas actuator systems operating in a bi-stable mode.

In a closed-loop arrangement, increasing the system gain to the point of infinite gain produces bi-stability, i.e., the servo valve can assume only two positions. Fully closed in either direction, maximum corrective torque is thereby applied to the load for all errors. With infinite gain, the system will sustain steady-state limit-cycle oscillations, and the average steady-state error is zero. This is significant as systems with large static loads, more proportional controls of conventional philosophy permit larger errors before action torque is overcome.

Among applications for CECO's limit-cycle, bi-stable philosophy is thrust-vector control. A representative portion of such a system is shown schematically at the left. The design utilizes part-pull actuators. The bi-stable motor, valving and actuators are an integral unit. One large servo-actuator positions the mechanically-linked pitch nozzles, while two smaller actuators position the remaining nozzles in response to yaw and roll commands.

CECO's experimental development program has demonstrated that because of inherent economy and insensitivity to contaminants, the bi-stable control is more reliable than other proportional configurations for solid fuel applications.

TYPICAL PERFORMANCE OF A BI-STABLE CONTROL

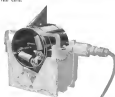


Response of this system to one, ramp and two inputs (while using a conventional proportional) is illustrated. With two one periods delay inserted, final state oscillates at the rate of one degree per second.



Much of CECO's hot gas system and component development work is carried out in a control facility comprised of the above control room and its associated test cells.

Shown mounted in a test rig, this CECO hot gas system was designed for control-surface actuation.



Familiarity with systems engineering and with precision manufacturing for aircraft and missiles has served CECO well in its extensive work with hot gas servo control systems.

Both actuators and reaction systems have been designed, developed and produced for use with high-pressure hot gas generated from either solid or liquid propellants.

An up-to-the-minute, color-slide presentation containing technical data and a review of hot gas component and system hardware development activity at Chandler Evans is currently available. To arrange to have this presentation given before an engineering group in your company, call or write your nearest CECO Field Engineering Office.

FIELD ENGINEERING OFFICES

WEST COAST

William E. Gentry
2240 Mulholland Boulevard
Hollywood 28, California

MID-WEST

Kenneth L. Moore
Room 335
Quiver Building
Chicago 4, Illinois

EAST COAST

Edward M. Campbell
Chandler Evans Corporation
Quaker Oak Road
West Hartford 4, Connecticut



Airline Income & Expenses—February, 1960

(IN DOLLARS)

	Passenger Revenue	U. S. Mail	Expense	Freight	Charter	Total Operating Revenue	Total Operating Expense	Net Income Before Taxes
DOMESTIC TRUNK								
American	34,321,728	812,840	342,724	1,941,348	—	36,065,816	1,944,700	34,121,116
Boeing	4,933,426	131,433	71,432	144,424	5,489	5,495,498	5,714,866	-219,368
Capital	2,759,442	754,177	175,107	171,307	11,613	3,241,262	6,728,842	-3,487,580
Continental	3,748,200	61,280	42,009	30,283	23,283	4,034,855	4,494,464	-459,609
Delta	6,740,500	138,500	127,600	312,360	—	7,172,800	7,736,100	-563,300
Eastern	81,366,736	434,611	164,561	14,279	10,819,419	93,821,265	93,101,262	720,003
Northwest	3,844,232	182,981	76,364	124,191	14,749	4,232,741	4,444,749	-212,008
Pacific	3,528,710	68,323	32,743	61,524	—	3,749,710	3,884,460	-134,750
Pacific Northwest	12,551,454	193,428	103,784	—	—	12,844,662	13,131,257	-286,595
Texas World	14,441,434	540,588	1,399,423	—	134,000	16,272,545	16,574,579	-3,022,034
United	16,419,441	762,243	1,014,120	63,774	19,641,417	38,247,776	37,237,232	1,010,544
Western	4,475,469	147,743	194,445	12,724	5,719,356	6,367,704	367,282	5,999,422
INTERNATIONAL								
American	410,737	8,424	36	31,499	684,694	1,127,354	87,189	1,040,165
Boeing	414,745	173,308	49,468	—	724,770	1,359,323	123,563	1,235,760
Continental Atlantic	350,731	2,519	14,761	1,324	234,077	589,412	81,691	507,721
Delta	224,680	4,008	7,000	—	244,688	476,376	164,000	312,376
Eastern	1,931,671	48,472	40,532	3,716	13,340	2,025,740	3,241,274	-1,215,534
Northwest	1,871,471	—	—	—	294,076	2,165,547	194,382	1,971,165
Pacific	1,023,223	1,149	431	3,179	119,299	1,147,880	46,128	1,101,752
Pacific Northwest	1,647,245	221,144	242,513	—	—	2,110,902	2,248,274	-137,372
Pan American	20,741,000	1,844,800	3,425,000	479,500	37,816,044	62,826,344	6,274,000	56,552,344
Texas World	170,008	14,800	38,000	—	442,619	627,427	519,000	108,427
United	7,873,426	424,800	1,083,400	144,500	16,279,700	24,701,826	24,840,000	-138,174
Western	6,478,000	242,800	6,478,000	6,478,000	6,478,000	12,956,000	12,956,000	—
Alaska	4,208,000	619,800	815,000	21,000	7,946,000	12,910,800	14,000,000	-1,089,200
Pacific	1,504,000	14,800	16,500	12,800	1,403,500	3,437,600	3,446,000	-8,400
LOCAL SERVICE								
American	481,417	10,760	11,743	13,415	1,484	507,773	3,526,943	-3,019,170
Boeing	377,457	1,546	5,474	2,712	384,588	867,377	891,629	-24,252
Capital	136,447	4,684	9,205	6,712	5,729	167,785	464,884	-297,099
Continental	420,414	10,760	4,211	24,261	4,431	469,886	1,114,400	-644,514
Delta	11,347	4,600	2	—	—	16,549	261,046	-244,497
Eastern	479,414	4,214	7,453	14,923	13,438	515,042	1,064,557	-549,515
Northwest	915,227	39,714	18,000	10,265	1,344,111	2,317,317	2,317,317	—
Pacific	825,716	12,474	14,445	—	—	842,635	1,000,000	-157,365
Pacific Northwest	476,445	9,247	4,444	9,233	37,434	537,363	564,276	-26,913
United	341,232	4,233	7,122	4,844	487,479	834,888	112,044	722,844
Western	327,444	11,474	4,243	14,400	5,789	363,346	670,896	-307,550
Alaska	424,444	4,247	5,294	7,117	363,457	895,362	799,360	96,002
NON-TRUNK LINE								
American	304,342	1,794	4,443	4,474	796,143	1,106,753	21,444	1,085,309
Boeing	445,429	3,707	41,407	71,701	347,287	868,324	727,007	141,317
CARRIER LINE								
AARCO	—	—	—	11	434,367	434,367	136,524	297,843
American Red Airlines	—	—	—	164,779	143,367	308,146	6,944	299,202
Plying Tiger	—	22,450	401,077	—	467,201	933,678	—	933,678
United	—	—	—	403,000	—	403,000	—	403,000
Western & Windsor	—	—	—	1,122,362	7,811,888	8,934,250	75,444	8,858,806
Wick	—	—	—	—	—	—	—	—
NON-CODED LINE								
Alaska Pacific	120,124	106,450	—	—	—	226,574	—	226,574
Los Angeles Airways	74,909	11,749	10,341	—	10,341	103,740	3,476	100,264
New York Airways	79,204	4,290	4,444	—	238,523	322,061	2,444	319,617
ALASKA LINE								
Alaska Airlines	158,234	20,434	229	16,399	217,311	402,368	59,546	342,822
Alaska Coastal	30,444	10,467	2,444	10,444	14,444	60,444	22,127	38,317
Alaska	1,131	7,215	8,311	12,444	10,444	39,510	10,444	29,066
Delta	44,444	7,244	7,244	—	124,444	183,444	7,444	176,000
Northwest Coastal	49,419	44,272	27,334	8,477	—	129,444	—	129,444
Pacific Northwest	212,444	97,344	1,234	24,749	—	335,444	126,114	209,330
Pacific Northwest	212,444	97,344	1,234	24,749	—	335,444	126,114	209,330
Wain Alaska	42,342	47,124	30,477	31,071	226,799	477,333	—	477,333

† Not available. † Property taxes. † Not operating income/loss. † Airline divided figures. † Common carriage.
 † Includes Federal subsidy. † Expense & income/loss. † Airline divided figures.
 † Includes & other West from airline reports in the Civil Aeronautics Board.

NEW

emr SUBCARRIER DISCRIMINATOR

ALL SOLID STATE...PHASE-LOCK-LOOP DETECTION...MINIATURE...FOR TELEMETRY AND DATA REDUCTION



MODEL 167A Solid State Discriminator (full rack width)

The new emr Model 167A Subcarrier Discriminator is a precision instrument designed for demodulating FM subcarrier signals with exceptional linearity. The new Model 167A employs phase lock loop detection in completely solid-state circuitry to achieve outstanding characteristics of performance and durability in a miniature package. The new discriminator has a true 50 db dynamic input voltage range. Amplitude of each subcarrier signal can be as great as 5V rms in a modulation of up to 58 subcarriers. Amplitude modulation effects such as tape drops are virtually eliminated by dynamic limiting, effective over a true 60 db voltage range. The design is such that phase-locked-loop characteristics are automatically optimized regardless of channel selector used and output filter chosen. The channel selector delay network provides fine tuning to slow tape speed and buffer compensation of better than 100:1. The Model 167A is available with an extended 1000 cycle/sec frequency, frequency dividers, and intelligence frequency outputs. The new Discriminator is packaged in less than half normal panel width. Two can be installed side by side in a 19" rack, using a single battery.

See the Model 167A at Booths H1, H2, H3 and H4 at the Conference

For complete information write:



Electro-Mechanical Research, Inc.

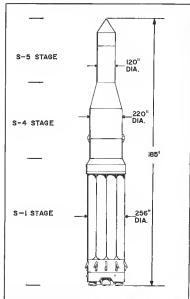
P. O. Box 3041, Sarasota, Florida

CONDENSED SPECIFICATIONS

Carrier Frequency: 1800 standard, up to 3000 AC available
 Frequency Response: 100 Hz standard, up to 4000 Hz available
 Intelligence Frequency Output: 1800 standard, up to 4000 Hz available
 Input Dynamic Range: 60 db, 5 V to 50 mV
 AM Rejection: less than 0.3% peak bandwidth change for 20 db input step change
 Unwanted Signal Rejection: 60 db rejection of 1 V, 1 modulation on adjacent channel having 36 db greater amplitude
 Linearity: 0.05% of bandwidth with respect to best straight line
 Type-Input Compensation: greater than 100:1 reduction of wear and tear up to 10%
 Output Stability: 0.05% of bandwidth in 24 hrs after 8 hr warm-up
 Supply: 5V regulated, output control adjustable 0.1 V to 0.35 V at 500 mA load (up to 100 mA intelligible)
 Power Consumption: 10W at 120V rms
 Size: 3 1/2" x 5 1/2" panel over all depth, 10"
 Mount: Two rail-mounters provided—Bussman Votco and 50 Output

Safety, Simplicity Stressed in Saturn Design

By J. S. Reitz, Jr.



SATURN C-1 vehicle is the first of a family of three which are planned. First two stages of the C-1 can be used to place a cluster of the Deimos-type (about 15,000 lb. gross weight) into orbit. S-5 stage probably will not be used during the burning of large weight vehicles because of severely placed stresses in the light. Flight testing of the first engine cluster can be accomplished with the first two stages of the Saturn C-1. The middle engine would be placed in orbit and then tested. Booster is due to fly as early as 1961; complete C-1 vehicle will fly late in 1963.

Huntsville, Ala.—Consistency and simplicity are stressed in the detail design of National Aeronautics and Space Administration's Saturn booster as an effort to counteract the reliability-enduring effects of its great size and the dual thrust engine concept.

The major conservative design features were considered necessary in the Saturn first stage by the vehicle's designers, the Development Operations Division of the Army Ballistic Missile Agency, headed by Dr. Werner von Braun, which will be absorbed into NASA July 1. These conservative features provide numerous assurances that the Saturn will perform its vital mission of increasing U. S. space payload capability to 15 tons and more. The features are:

- **Redundancy** in performance, necessary to permit the Saturn 1.5 and the 4-stage booster as compared with that of the first stages of current space vehicles. Saturn boosters control velocity and position along the trajectory at burnout any way within wide limits to relieve the need for precise propellant management controls on the eight engines in the cluster and to eliminate the requirement for small reserve engines. First stage of the Saturn will boost the upper stages to Mach 4 at 5 and immediately above 100,000 ft. on most missions under study. Precision trajectory will be achieved by the upper stages.

- **Structural safety factors** on the Saturn booster are approximately 20% above those normally used on large rockets. This increase in strength puts the Saturn in approximately the same class as commercial transport aircraft from a structural safety point of view. This decision was made because the Saturn configuration calls for it to boost manned vehicles into space. The weight increase does not impose an excessive performance penalty on very large rockets as it does on those of the size of present ICBMs. The added strength was also attractive because of the necessary requirement for the Saturn booster.

- **Capability of completing a mission** if two of the eight engines malfunction and stop. One engine may stop a fraction of a second after liftoff, and a second may stop firing about 60 sec. later with no adverse effect on the mission. It is necessary, however, that three of the four gimbaled engines function

Approach

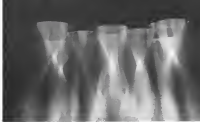
properly throughout the flight if total lift is to be maintained. Failure of the booster is counteracted so that, even if two engines are shut down, the tanks will crash together.

- **Simplified design** of the eight clustered Rocketdyne H-1 engines eliminates the extensive electric gas-turbine multi-valve starting system. Engine starting and stopping are accomplished through a single electrical signal and do not require a matrix of valves and pressure switches in the squibs or pipes. Improvements also were made in the bellows arrangement on the propellant lines running out of the high pressure side of the turbopumps, which, along with relief, have been one of the most frequent causes of engine trouble in the past in the case of Army Ballistic Missile Agency personnel. The turbopumps were mounted on the side of the combustion chamber so that these bellows that cause the most and are under the most strain during engine starting would be on the less pressure propellant lines from the nozzles into the pumps. Previously, the turbopumps were attached to the nozzles above the engine, and the high pressure lines to the gas-drawing chamber combustion had to move through large angles and were subjected to more severe vibration than they are on the new design.

- **More than 600** telescoping shrouds will be used to insulate transport personnel, vibration stresses and other conditions at many points on the booster during flight tests. This is apparently double the maximum number of shrouds that were mounted during the development of previous rockets, but it is considered necessary if the current progress goal of using only 10 development vehicles is to be met. Approximately 1,200 vehicles were lost during the development of the German V-2 missile, and about 40 were launched before German A-9s was operational.

Short and Launch Sequence

Saturn C-1 vehicle (see drawing, left) will be the first of the Saturn family to reach flight test. The C-1 is a three stage vehicle using the S-1 booster as the first stage, the S-4 stage as the second and the S-5 stage as the third stage. Powerplants for the S-5 stage will be two Pratt & Whitney XLR-11, 15,000 lb. thrust liquid hydrogen rockets and its structure will be designed and built by General Electric. The S-4 stage will be four XLR-115 rockets

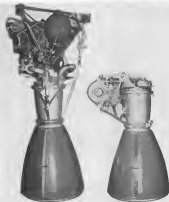


SMALL SCALE tests of the line leading to be required on the Saturn booster were run with a cluster of 250 lb. thrust engines in the wind tunnel at NASA's Lewis Research Center (above). One-tooth scale model of the Saturn launch stand is still under development and hold-down mechanism is below.





OPERATION of the Sabers recovery system is outlined above. Raskers will be fired by a water-activated switch hanging 180 ft below the buoy. The rockets will allow the booster to enter the water at almost any velocity. Rocketdyne engine for the Jupiter module (below, left) is compared with the company's H-1 engine for the Sabers. Simplified start system, turbopump and auxiliary equipment for the H-1 are mounted on the side of the combustion chamber.



uprated to 10,000 lb thrust and
Alenia is the prime contractor

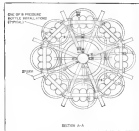
The Saturn C-2 four-stage vehicle will be identical to the C-1 except that the S-3 stage will be oriented in between the S-1 booster and the S-4 stage. Two, 100,000 lb thrust liquid-fueled rockets will power this stage. The contractor for these engines and for the S-3 airframe have not been selected.

The five stage Soham C-5 will be the C-2 vehicle with the S-2 stage added between the S-1 boosters and the S-3 stage. The S-2 stage will be powered by five of the 200,000 lb thrust liquid-propellant engines of the same type as used in the S-1 stage. Airframe for the S-2 stage probably will not be constructed out for many months.

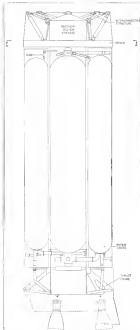
Simplicity of the Suman browser operation is also illustrated by a rundown of the starting sequence for its night engine and the operation of its launch stand.

Once the propellant loading operation has been completed, a single signal will start the eight engines almost simultaneously. The engines are started in facing pairs, with a built-in 210-millisecond delay between each pair so that the structure will not receive an unbalanced load in the full 1.5-millisecond interval at once.

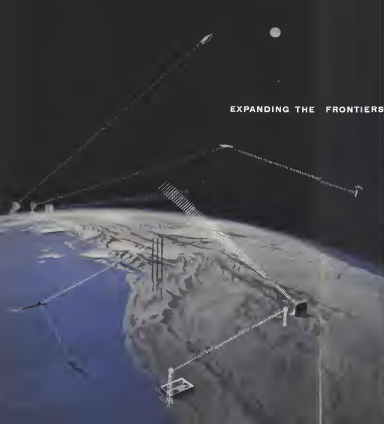
Starting signal to each engine opens a solenoid-operated cartridge which brings its turbopump up to speed. When the pump reaches the proper delivery pres-



WIND TUNNEL model of the Hinton S-1 boundary layer on the leading edge of the L-1011 Starliner. The model is 270 ft long. The topography of the wing is shown on the base of the model (note the leading edge boundary). The flow velocity and boundary layer thickness are shown on the base of the model. The model is mounted on the water supported carting system to allow the model to be moved in the wind tunnel. The model is mounted on the water supported carting system to allow the model to be moved in the wind tunnel. The model is mounted on the water supported carting system to allow the model to be moved in the wind tunnel.



GENERAL—An overview of the main structural elements of the Spine S-1 is shown above. The engine is attached to the thrust frame of the main. Propellant tank configuration is shown in section A-A (below left). The crane hook, built by Spine, is seen near fibrous tank on the right of right which connects to the main. All structural loads are carried by the thrust frame, the five liquid engine tanks and the "spine" at the top of the tanks which has the connecting structure to the stage above. Most of the fibrous tanking equipment on the S-1 will be located above the "spine".



EXPANDING THE FRONTIERS OF SPACE TECHNOLOGY IN

COMMUNICATIONS



By 1960, the human, records 500 P.C. (the use of dispatch sticks for military signaling). This is the foundation of the telegraph, known by Sir Henry C. Morse, a book came into a life too previous later.

Lockheed's interest in developing the science of communications extends from the depths of the ocean to deep space. Its Missiles and Space Division research programs deal with the development and application of statistical communication and decision theory in such areas as communications, telemetry multiplexing and modulation, scatter communications, multiple vehicle tracking, reflector wave generation and utilization, sonic signal detection and processing, avoidance of multipath degradation and interference avoidance.

Associated research and development efforts are directed toward propagation studies and advanced antenna design, low noise amplifiers, vehicle borne signal transmission and reception, data storage and processing, solid state electronics and devices.

The scope of such activities extends from advanced studies of naval communication problems on and under the ocean, the many applications to missile vehicles, on to the specialized communications problems of deep space exploration. Latter needs are exemplified by high frequencies, low weight and power, high stability, low effective bandwidth, extreme reliability and basic simplicity requirements.

Engineers and Scientists: Investigating the entire spectrum of communications is typical of Lockheed Missiles and Space Division's broad diversification. The Division possesses complete capability in more than 40 areas of science and technology—from concept to operation. Its programs provide a fascinating challenge to creative engineers and scientists. They include: celestial mechanics, communications, computer research and development, electromagnetic wave propagation and radiation, electronics, the flight sciences, human engineering, magnetohydrodynamics, most in space, materials and processes, applied mathematics, oceanography, operations research and analysis, optics, radiation and plasma propulsion and exotic fuels, sensors, space medicine, space navigation, and space physics.

If you are experienced in work related to any of the above areas, you are invited to inquire into the exciting programs being conducted and planned at Lockheed. Write: Research and Development Staff, Dept. E-17A, 962 W. B. Canyon Road, Sunnyvale, Calif. U.S. citizenship or existing Dept. of Defense clearance required.

Lockheed / MISSILES AND SPACE DIVISION

Systems Manager for the Navy POLARIS FBM,
the Air Force AGENA Satellite in the DISCOVERER,
MIDAS and SAMOS Programs, Air Force X-7, and Army KINGFISHER
SUNNYVALE • PALEO ALTO • VAN NUYS • SANTA CRUZ • SANTA MARIA • CALIFORNIA
CAPE CANAVERAL, FLORIDA • BLANKENBURG, NEW MEXICO • HAWAII

A TALENT FOR COMMAND CONTROL SYSTEMS

TIME... vital element
in our nation's defense.

Response to attack
must be immediate.
The higher speed
and greater range
of more lethal weapons
demand that Commanders
of future military systems
have a new degree of control
that only electronics
can provide.

Before the command decision
is possible,
a mass of information
must be gathered from
sensing defense elements,
correlated, and presented
to the Commander and his staff
in readily understandable form.
This is the function of the
Command Control Systems.

The speed and efficiency
of this system must be such
that it shall never
have to be used of necessity.

*Stromberg-Carlson
advanced developments
in electronic communications,
processing and display
of intelligence -
the nucleus of
a proven talent for
Command Control
Systems.*

In reduce on request



STROMBERG-CARLSON
A DIVISION OF **GENERAL DYNAMICS**
1400 NORTH GOODMAN STREET • ROCHESTER 3, N. Y.

ture in the flow on its high pressure
side, a butterfly valve opens to per-
mit the propellant to flow, then the in-
jector valve in the combustion cham-
ber. The sudden pressure rise in the
injector system ruptures a diaphragm
and releases a charge of aluminum in-
difer into the combustion chamber.

The liquid reaches the combustion
chamber at the same time as the pro-
pellant, and their reaction is hetero-
geneous, causing turbulent burning of
thrust is very rapid as the J11 engine
near the elaborate start controls have
been eliminated. Engine starting and
burning will take place in about 1/2 sec.

The engine's hold-down mecha-
nism on the launch stand will be trig-
gered by instruments which measure
the chamber pressure on the right en-
gine. When the chamber pressure, of
all of the engines reach full thrust
value, four of the hold-down arms will
slide back from the booster for about
three feet. As these arms reach the
limit of their travel along their tracks,
they will strike a switch which, in turn,
will release the final four hold-down
clamps that operate on a flipback prin-
ciple.

If the chamber pressure on one of
the engines fails to make the normal
rapid thrust acceleration, its measure-
ment pressure the stop sequence, after then
the launch sequence, is automatically
engaged. This stop sequence consists
of just one signal to each engine which
triggers a solid propellant cartridge that
stops the turbocharger. When the pres-
sure in the propellant tank is lowered
in this manner, the spring type valve in
the tank closes.

Thrust regulation in each engine, a
screwthread simply by placing orifices
in the fuel line to the gas generator
which powers the turbocharger and, in
the high pressure propellant lines, to
the combustion chamber.

These orifices restrict the flow to that
required to produce a given thrust.
Thrust of the eight engines in each
cluster will be closely matched through
fuel metering and calibration to select
the propulsive action for their boost.
This subassembly procedure takes about
two short hours for each engine.

Liquid rocket engines on most of the
large missiles now in use have a great
drawback: fuel control system, although
this cannot be considered to be
thermostable. These engines have the
same orifices on their lines but also have
a closed loop for the turbocharger to
regulate propellant flow to match any
fluctuations in combustion chamber
pressure and other engine operating
parameters. The state of the art has
progressed to the point where such con-
trol systems are not necessary on the
Suzanne H. I. engines in their jet rough-
burning or other engine applications.

Also, a successful flight by the



Here is a man you should know he's a **DELAVAN FUEL INJECTOR SPECIALIST**

James H. Brecker specializes in injection devices using flow controls. He's a
Suzanne Proprietor Engineer with Delavan. And during his many years of developmental
experience, his products have become ball-of-natural items on some of the
world's most advanced jet engines for aircraft and missiles.

If specialized engineering talent like Jim Brecker's that has made Delavan first
choice for fuel injection problems solving. If fuel metering and atomization are
part of your product, take advantage of Delavan's specialized experience and
proven ability to deliver aircraft quality. Send specifications to the address below
for Delavan's free recommendations.



DELAVAN
Manufacturing Company

WORLDWIDE MANUFACTURER OF VALVES • NEEDLES • NOZZLES • PIPES

FEWER MOLECULES MEAN STRONGER WELDS



When this 40-foot vacuum chamber (shown) is completed in 60 months, a single weldable unit, tested 15 feet with all welding under vacuum, will be made.

Many of today's "space" metals have an affinity for contaminants at high temperatures making welding an extremely critical operation. The Budd Company—pioneer in welding techniques—has solved many of the problems of making reliable welds in such metals as titanium, hafnium, beryllium, columbium, tantalum and molybdenum.

Parts to be welded are placed in a vacuum chamber. The chamber is pumped down to .03

microns, to rid the box of contaminants; then is immediately refilled with inert gas to atmospheric pressure. Not only stronger, high quality welds—impossible with conventional methods.

We are prepared to fabricate these materials today. Why not let us know how we can work with you? SpaceAeronautics Division, The Budd Company, Philadelphia 32, Pa.

SPACEAERONAUTICS
Budd DIVISION

the chamber, the major impurities are the oxygen and nitrogen molecules for all welding, which is performed from the ground in an oxygen-depleted atmosphere. During that vacuum, the weight of propellant left in the subconnected tanks.

First phase of the Saturn recovery sequence has not yet been fleshed out, but the major considerations are the first decontamination phase, which plans to capture most of the propellant in a solid trap, spend weeks behind the booster to cables. The cover of the decontamination and control system can perform as top of the booster shell. The propellant tanks also have been considered for possible use as a speed brake.

During the first phase of the recovery, the booster will have to be slowed down from Mach 4 or 5 to a speed between Mach 1.5 and 1. Then, the first phase decontamination device will be dropped, and a single, silicon-type parachute will be used to reduce the booster's speed to Mach 0.5 or 0.7, according to present plans. This parachute will then be dropped, and three 100 ft. chutes will be deployed to slow the booster's descent to 60 or 90 ft. per sec.

This final terminal velocity will be removed by eight solid propellant rockets that will burn for slightly more than a second so that the booster will theoretically strike the water at zero speed. If there is no wind to give it a horizontal velocity component. The eight solid propellant decontamination rockets are rigid around the base of the booster just above the main engines. This will be triggered by a radio-controlled switch suspended below the booster on a 100 ft. line. Design of the recovery system is being handled under contract by Cook Electric Co., of Chicago.

Water Impact

On most rockets, the booster will enter the water about 200 ft. down range from the drop point at the Air Force Missile Test Center, Cape Canaveral. It will then crash through the buoyancy of its propellant tanks. A crew, as a Navy Landing Ship Dock, will be placed to hit the booster from water and place it on the barge that transported it from the Marshall Space Flight Center in Huntsville.

Disassembly and draining of the booster engines will begin immediately in order to prevent corrosion damage. These engine parts of the water impact test, will then be returned to the government and used in the assembly of new engines. In a protected row that almost all these parts, which separate a large portion of the booster cost, will be reusable.

It also is believed that the propellant tanks, booster thrust structure and other parts of the engine will require little damage and will be reusable. The

booster being made of 74% aluminum alloy which yields and requires little strength at its end. The optimum steel from a strength to weight ratio should point.

The Saturn booster and its transport barge can both be loaded about the 15th and taken to New Orleans to start the recovery sequence. To handle the recovery sequence, a required in the program. Several districts will be used in the recovery of the booster. The barge will be out of the preferred 17 day barge trip around the tip of Florida and up the Mississippi. Ohio and Tennessee receive from the recovery area in the Marshall Center.

Booster Assembly

Current plans call for the assembly and test of the parts fabricated for the 10 Saturn development rockets to be carried out at the Marshall Center. If any subcontracting of the booster assembly begins part of the construction of the first operational vehicle.

No. 11 probably will involve the propellant tanks. NASA's priority occurs before phasing industry contractors for the fabrication of Saturn booster parts will be to make sure that the contractors are funded and that there will be no further changes to the manufacturing and testing costs.

A large percentage of industry contracting is planned for the manufacture of the operational Saturn booster. Final assembly of the operational booster and tests of these functional systems probably will be completed at Huntsville, to reduce the load on the checkout and launch facilities at Cape Canaveral.

Major portions of the development testing of the upper stages of the Saturn vehicles will be conducted by the industry contractors in charge of their design.

A third liquid hydrogen vehicle probably will be constructed at the Marshall Center, however to permit government personnel there to be on-site, familiar with the problems of handling the propellant which will be used in all of the Saturn upper stages. Marshall Center officials believe that this must have personal knowledge of the national problems facing their contractors if they are to avoid their competitors in the market. The liquid hydrogen fueling facilities at Huntsville will allow the NASA personnel there to make a small contribution to the development testing of the Saturn upper stage engines.

Several stages of the Saturn booster is of the rigid wall type in contrast with the thin wall balloons or inflated pressure structure used on the Air-Titan-Centaur Atlas (TCM). Saturn upper stage probably also will use the rigid design with relatively heavy welded propellant tanks that are closely spaced external ring frames to prevent local buckling of the tank skin. Two



LISLE *Magnetic* CHIP DETECTORS

Metel particles in an engine or machinery indicate an on-going indicator of potential breakdown. Early detection of this condition is being accomplished today in both commercial and military aircraft, with Lisle Magnetic Chip Detectors. A powerful magnet in the Chip Detector attracts any ferrous particles that may appear in the lubricant. These particles lodge on electrically insulated pins, completing a circuit which activates a light on the flight engineer's or pilot's instrument panel. Early detection means constant protection against in-flight failure.

As an alternative to a permanently wound system, Lisle Chip Detectors can be easily checked with a continuity tester.

Write for Catalog and Samples
LISLE for Testing
CORPORATION
Gardens, Iowa

Titanium trims DC-8 airframe

by 945 pounds

(equals 5 passengers, or 1/2-ton of freight...for life!)

DOUGLAS AIRCRAFT COMPANY, INC., has never built an airplane that failed to show a profit for its operators. Based on the experience of United Air Lines, the first carrier to fly the airplane, the latest Douglas ship, the DC-8 jetliner, indicates it will push that record forward. Here's how use of titanium contributes to the total efficiency of the airplane and what that efficiency means in dollars and cents.

The flying stiffness of the DC-8 jetliner provides its operators a basic economy almost nonexistent in current design. Payback on every flight without research or development costs to be amortized. That's how Douglas engineers size the value of titanium in achieving a minimum weight airframe structure.

Primarily an aluminum ship, the DC-8 offered few possibilities for weight savings during design. But where weight could be reduced—in pods and pylons, rig strappers and door doublers—titanium was selected.—800 pounds of commercially-pure grade Ti-75A for pods and pylons. 330 pounds of Ti-6Al-4V titanium alloy grade for rig strappers and door doublers. 15 pounds of nonaerospace titanium (Imperial, Metel) as supplied by Titanium Metals Corporation of America.



Titanium access panel, through which DC-8 engine will be serviced, is installed on the aircraft by two Douglas Aircraft Company line mechanics. Pods of the DC-8 have been so integral that titanium will completely seal off any engine.

Titanium door doublers give structural rigidity to Douglas fast-track approach to new design. DC-8 uses 330 pounds of Ti-6Al-4V alloy titanium produced by Titanium Metals Corporation of America.

The air itself is equivalent of a billion of seamless airframe weight for the DC-8. Lighter each DC-8 is expected to make during its seven-year useful



by 945 pounds

Interpretations of the value of weight savings include:

- DOUGLAS AIRCRAFT: "The 945 pounds (air weight saved) are equivalent to five passengers and their baggage for the entire life of the airplane."
- UNITED AIR LINES: "At the very least, the weight saved by titanium is equivalent to a half-ton of cargo. At full value, this would amount to a potential of \$235 for each saved ton-mile flight."

Why titanium?

Titanium, with a density of 0.163 lb/in³ is produced in shapes equal in or superior steel on a strength-to-weight basis. It is resistant to atmospheric corrosion or precipitation.

The availability of titanium has been restricted with demonstrated clarity. Examples:

- DOUGLAS has employed titanium in every commercial transport since its first DC-1, where titanium in fireproof nacelles and landing gear doors yielded 300 pounds of weight savings.
- PRATT AND WHITNEY AIRCRAFT reports that more than one million flight hours have been accumulated by more than 5,800 P.W. PT-3 and JT-4 engines using titanium door pods without a single failure of any titanium part, either through corrosion or mechanical damage. Both engines have been specified for the DC-8.
- Allowing for titanium's reliability in its "hopper" property," W. Stuart Lyman, Principal Metallurgist, BARTLETT MASON & COMPANY, made the statement in a lecture in Los Angeles March 10:

"We have tested six turbochargers from three large series of titanium aircraft. To a man, they reported that titanium parts receiving inspection, after fabricated, passed final inspection, and were assembled into the airplane, it is usually never tested again."

Is titanium competitive in price?

DEAN ALBRITTON, CHAIRMAN, which determines the bulk of the titanium supplies employed in the DC-8 commands industry-wide respect for its skill of craftsmanship and the titanium as used in every job. Example: To guarantee maximum cleanliness, Ryan's DC-8 final assembly building in San Diego has been so constructed that no doors or windows open in the direction of prevailing winds.

While overlooking the opportunity to improve upon any employer's means that titanium metal came more so than steel. Ryan has developed manufacturing techniques in fabricating titanium at prices roughly equivalent to steel's. The spread between "hot metal" and completed assemblies in this industry is usually more fabrication costs (use of materials, for greater than raw material costs).

Highlighting titanium's fabricability is Ryan's production of the access panels which cover the DC-8 engines. These panels—designed by the doors through which engines will be serviced for life—are made from three sections of 0.016" Ti-75A, 36" x 73", hot cold-rolled and welded together to form the skin of the completed door. Details such as doublers, channels, ribs and frames, are then welded or riveted to the skin. The completed product weighs 80 pounds and measures 162" long by 70" in the structure. Control of tolerances (manufacture tolerances are ±.005") is so highly developed at Ryan that these machine-appearing access panels are interchangeable with any pod built for a specific engine.

Titanium access panel, which covers engine of DC-8, resembles web-tension design (measures 162" by 70" and weighs 80 pounds). Composite titanium is considered as closely as monolithic with one and built for a specific engine. 800 pounds of titanium (Ti-75A grade Ti-75A) are used in DC-8's pods and pylons.



Where does titanium belong?

Titanium metal, both pure and the DC-8 as a basic design material, has been used in a variety of civilian and military applications in a direct volume-by-volume replacement for various materials in engine weight savings sufficient to permit improvements in service or payload capacity.

Although both weight reduction programs and the structural design value must be viewed in relation to the specific application, titanium's permanent resistance to atmospheric corrosion yields dividends immediately apparent to operators of commercial aircraft. It means 10 to 15 months free from operations shut down when maintenance issues not only repair costs, but also downtime of expensive equipment.

In pods, pylons, landing gear doors, turbochargers, strappers, and a host of similar parts titanium's weight savings (as measured in pounds) are greater than in steel and light alloy materials. Titanium's weight savings are measured in per cent/foot.

Why Titanium Metals Corporation of America?

Titanium Metals Corporation of America, the nation's only organization devoted exclusively to development, production and sale of titanium material, has wide interest in establishing titanium metal only in those cases where it is of value to you.

The interest arises from the basic belief that a satisfied customer is a steady customer.

This interest is manifested in TMC's primary efforts to meet your delivery schedules, to provide you with accurate information you need concerning properties of titanium and selection of finished materials, and to permit you to pass your requirements passed through TMC's (double-check) program.

Whether building new aircraft, or rebuilding operational ships, developing advanced methods or modifying existing units, you can rely on your weight savings with titanium.

TIMET®

TITANIUM METALS CORPORATION OF AMERICA
2323 Broadway, New York 7, N.Y.

SALES OFFICES: NEW YORK
CHICAGO • CHICAGO • BIRMINGHAM • LOS ANGELES

having features to maximize heat-bonding efforts.

Skirt around the engine was installed considerably between the first gimballed control engines on the outside of the cluster. The external large means of high energy air around the four center engines to prevent dual air regions near them.

Heavy insulation was placed across the base of the booster at approximately the throat section of the engine. This highly-reflective, gold-plated insulation does not fit tightly around the engines and base, but rather like a skirt made of square fiber cloth and attached to the firewall and the engine base but air from flowing back around the turbo-pumps and the gimballed fuel lines. A small firewall also has been placed between the nozzles of the four gimballed center engines at the nozzle exit area. This prevents overheating in the small space between the nozzles.

Turbopump exhaust flow from the four center engines is piped to the outside of the booster skirt and dumped into an area of constant high velocity air flow. Aspirators are used on the nozzles of the gimballed engines to mix the turbopump exhaust with the engine's main exhaust flow. If this is not done, it has not been said, the turbopump exhaust pipe would require a bellows joint which would allow the pump to

Lenin Space Prizes

Moscow-Lenin prizes have been awarded to Soviet physicist Sergei Vavzer, Aleksandr Chelidzev, Semyon Tsiklakov and Nikolai Pribludov for designing and making earth's outer defense belt and coupling a pattern of the distribution of charged particles, and by discovering that the atom has no any net electric pole, according to the Russian news agency Tass. They discovered that there is an atom near the earth's pole that is a few of radiation particles. They said.

parallel with the combustion chamber.

It is possible that flight tests will show that the present design will not completely protect the base of the booster from excessively high temperatures. One of the lines that probably will be used if this situation arises will be the use of air scoops into the bottom of the propellant tanks to direct some high speed air flow around the center engines. Use of air scoops is difficult, however, because the inlet area required for maximum flow changes with speed, altitude and pressure at the exhaust point. It is as much possible to have reverse flow through such duct systems during some flight conditions.

Extremely large scoops such as the Saturn vehicles are highly unstable. The center of gravity of the Saturn C-1 is located on the heavy booster, and the center of lift under most flight situations is several meters forward of the center of gravity on the light upper stages.

Problem of controlling a large unstable vehicle of this type with gimballed engines is more complicated than for the ICBM-type vehicle. The natural frequency of the big vehicle is low and approaches the natural frequency of the engine control system for the engines. When the control engines react slowly to correct the motion of the vehicle it is possible for them to get out of phase with the signals that caused them so that the motions are amplified rather than damped out.

If the control engines move too rapidly, it is possible for the mass effects of their movement to cancel out the control effect of this change in thrust vector direction. Mass effects can get ahead of thrust vector effects.

These problems are typical of those facing the designers of the new control system for the gimballed engines on the Saturn booster. This control system will have to be of a more advanced type than the other area control systems used on aircraft and missiles and these circuits are now in design.

BENDIX SR RACK AND PANEL CONNECTOR

with outstanding resistance to vibration

The Bendix type SR rack and panel electrical connector provides exceptional resistance to vibration. The low engagement force gives it a decided advantage over existing connectors of this type.

Adding to the efficiency of this rack and panel connector is the performance-proven Bendix "die-type" contact entry method. Insert patterns are available to mate with existing equipment in the field. Available in general duty, pressurized or potted types, each with temperature range of -57°F to +125°F.

Here, indeed, is another outstanding Bendix product that should be your first choice in rack and panel connectors.



FEATURES

Resilient Insert • Solid Shell Construction • Low Engagement Force • Close Entry Seals • Positive Contact Alignment • Continuous-duty gold plated Contacts • Plain-clear Bright Nickel • Fully Protected to Meet MIL Specifications.

SCINTILLA DIVISION
ELECTRIC MOTOR DIVISION



Export Sales and Service: Bendix International Ltd., 250 E. 42nd St., New York, N.Y. 10017

Foreign Sales and Service: Bendix International Ltd., 250 E. 42nd St., New York, N.Y. 10017



RELIABILITY IS THE TARGET

The moment of truth for a missile occurs at the instant of detonation and the G.O.D. we speak of is Confidence of Detonation.

For programmed detonation, missile firing in all its complex phases — safety, arming, firing — must provide the ultimate in RELIABILITY and PRECISION. To achieve these goals in such a highly specialized field, Reeves has established a separate plant area fully staffed and equipped, and devoted exclusively to the design, development and fabrication of advanced firing components and systems.

Whether your requirements are for complete firing systems or precision subassemblies, it will be worth your while to contact Reeves.



REEVES INSTRUMENT CORPORATION
A Subsidiary of Dynamics Corporation of America
Research Field, Garden City, New York

Marquardt Advanced Nuclear Systems for Air and Space

MARQUARDT EXPANDS WORK ON "PLUTO"



Broadened team effort with University of California's Lawrence Radiation Laboratory aims toward early feasibility demonstration of a nuclear ramjet reactor (Project PLUTO).

A supersonic, low altitude maneuver capable of weaving, turning and dodging unobserved by conventional radar while evading air-to-air intercept missiles - this is to be the mission of the Air Force's proposed nuclear ramjet-powered vehicle of virtually infinite range.

As an integral part of the team which is contributing to the country's all-out race for supremacy in weapons, Marquardt is working with the University of California's Lawrence Radiation Laboratory on the nuclear ramjet program, known as Project PLUTO.

Marquardt's basic PLUTO effort concerns preliminary design of the nuclear ramjet and development of nuclear reactor controls and other components for severe temperature and radiation environments. The multi-million dollar program supports a multi-phase corporate effort headed by the Nuclear Systems Division.

Other aspects of Marquardt's PLUTO effort include support of LRRL's feasibility tests on the non-flight Tory II-A reactor, design and fabrication of significant

portions of the reactor's control system, air ducts, flow instrumentation, and remotely operated diagnostics; fabrication and test of reactor core structural components; aerobical engineering on the test air wedge system; participation in a supporting program of environmental tests; and preliminary design of test facilities for full-scale power-plant development.

Highlights of the Corporation's other current nuclear programs include: exploration of both military and non-military applications for transportable reactors of advanced design, including their use for space power; development of the engine control system for the G-6 nuclear turbopump; research studies of advanced space propulsion devices utilizing nuclear concepts; materials and processes work with molibdenum, other refractory metals and ceramics; and development of integral nuclear instrumentation.

As a step of Marquardt's new "Nuclear Systems" business, write to Mr. Adam Boush, Chief Applications Engineer, Nuclear Systems, The Marquardt Corporation, Van Nuys, California.

THE NUCLEAR RAMJET



Nuclear Systems Division of The Marquardt Corporation is engaged in a continuing search for engineers and scientists capable of establishing advances in nuclear power of the-art. Current expansion within this division creates challenging opportunities for: REACTOR PHYSICISTS • CERAMICISTS • NUCLEAR ENGINEERS • METALLURGISTS.

Qualified men are invited to contact: Mr. Lloyd Hargis, Manager, Professional Personnel, The Marquardt Corporation, 34528 Ruffalo St., Van Nuys, Calif.

NUCLEAR SYSTEMS DIVISION

THE *Marquardt* CORPORATION

34528 RUFFALO STREET, VAN NUYS, CALIFORNIA

ASTRO • COOPER DEVELOPMENT DIVISION
• DIESEN DIVISION • FORDSON DIVISION
• POWER SYSTEMS GROUP

CORPORATE OFFICES: VAN NUYS, CALIFORNIA

TAKE A GIANT STEP

...into your future and seek out the professional opportunities awaiting creative engineers and scientists at Martin-Denver. For here exists the most challenging problems in space and human engineering. Join with us and communicate with N. M. Pages, Director of Technical and Scientific Staffing (Dept. CC-105), The Martin Company, P. O. Box 170, Denver 1, Colo.

MARTIN
DENVER



McGraw-Hill TECHNICAL WRITING SERVICE

TWO offices you a single INTEGRATED publishing service prepared to analyze take a project from research and planning through finished manuscript and all typesetting, mechanical preparation, printing and binding. Whatever the situation, whatever the type of literature you need, our editorial and design consultants can help you bring to play the most experienced job the craft and skill of publishing experts.

WRITING EDITING ILLUSTRATING PRINTING

TO YOUR OWN OR
GOVERNMENT SPECIFICATIONS

Whether you need an illustration book or service manual, to accompany your equipment, to give government specifications... or product catalogs or training booklets... or annual reports... our writing staff can do the job for you. Our artists can create and illustrate the diagrams. And McGraw-Hill printing, binding and paper resources are among the best in the country.

SAVE MONEY AND TIME
LET OUR STAFF BE
YOUR STAFF FOR
TECHNICAL AND BUSINESS
PUBLICATIONS
ASK
OUR REPRESENTATIVE
TO CALL

Write to Phone
Technical Writing Service
McGraw-Hill Book Co., Inc.
330 W. 42nd St., N. Y. 36, N. Y.
60Days 4-3066

MISSILE ENGINEERING

Machining Improvements Cut Man Hours

By Michael Yaffee

New York—Improvements in machining over the next decade are expected to cut man-hour requirements in half and enable aerospace manufacturers to work high temperatures, high strength materials with speed, precision and low cost not now possible.

In the fabrication of high speed aircraft, missiles and space vehicles, aircraft manufacturers are using a host of new, high strength metals and alloys that are proving difficult, expensive and, in some cases, impossible to work by conventional machining processes.

To overcome these drawbacks, industries and the Air Force, particularly the Air Materiel Command's Manufacturing Methods Division, are carrying out an extensive program aimed at the development of new machining techniques and equipment. This program has now begun to pay off in a number of promising new developments.

Among the more prominent of these are material removal developments are the following:

• **Hot machining.** Conventional tools, such as carbide cutters, are used. The work material is heated (possibly by induction heating) just ahead of the cutter so that it is much weaker than the parent metal. This method can be used on high strength metals, super alloys and the refractory metals. In addition to enabling manufacturers to machine the "non-machinable" high strength metals, the technique has already tripled cutting speed and, over the next 10 years, may increase permissible cutting speeds by another 100%. Still in the research and development stage, hot machining is being investigated by The General Motors Machine Co. under an AMC contract.

• **Ultra high speed machining.** Nowadays, as cutting speeds increase, tool wear also increases. But there is more reduction—highly tapered and disintegrated—that beyond a "valley of death" (a cutting speed range in which tool temperatures and cutting forces become thousands of times higher than tool temperatures and wear begin to dominate. Since 1915, Lockheed Aircraft has been investigating machining speeds about the currently accepted limit of 15,000 fpm under an AMC contract. The approach has been to use guns which shoot work pieces across fluid tools. Some nickel-silicide coated tool surfaces are being used in a related effort because the

original alloys didn't take into account the buildup of inertia forces. Others, such as General Motors' Miling's Dr. Eugene Merchant, believe the idea is worth investigating for possible long-range payoff. At Dr. Merchant's report at the recent Society of Automotive Engineers National Aerospace Meeting, the only way to find out what happens at these ultra high machining speeds is through experimentation, since there is no equipment to use as a guide.

• **Chemical etching.** This technique, in which chemical etchants are used to remove metal, is now being used extensively in the aircraft industry in the fabrication of aluminum and magnesium aircraft components. Although a comparatively slow method of removing metal, it offers the advantage of being able to work precisely over a broad exposure of material at one time. Because there are no cutting tools involved, there is no tool wear as such. Too chemical etching is not limited by the strength of the material. To some extent, it is being used on high strength alloys and super alloys. But the use of chemical etching on high strength materials is still more of a development effort than a production operation and will be used only for problems in rework and removal of excess metal.

• **Electrolytic grinding.** In this process, which is now a commercial operation, a carefully chosen abrasive wheel is used along with an electrolyte. The abrasive wheel and work piece are connected to a constant current and a potential is established between them. The bulk of the

metal is removed by electrolysis (dissolving) with the abrasive wheel primarily as a scrubber and spacer to remove scale and to prevent shorts. Essentially a cold operation electrolytic grinding does not produce any friction effects. Factors on the work piece are reduced and tool life is increased. Also, the process offers a higher metal removal rate than conventional grinding and will work on high strength materials as long as they are electrolytically conductive.

• **Electrochemical machining.** Like electrolytic grinding, this process removes metal by dissolving or depositing, but it does so without the use of a grinding wheel and so is not limited by the geometry of the grinding process. The process, which can be considered either as an electrical assist to chemical etching or a simplification of electrolytic grinding, is close to a universal machining process, says Dr. Merchant. It also possesses the potential of a higher metal removal rate. This rate is directly related to the amount of current used but in practice would be limited by the amount of heat generated. Electrochemical machining will work well on very high strength materials that are conductive, and as rate of penetration is expected to jump at least fivefold in the next decade. At the present time, this process is in virtually still in the development stage. Among other things, there is a need for clients to get the process parameters for suitable electrolytes and for an environment in surface finishing.

• **Electron beam machining.** This is a

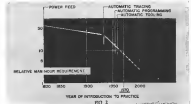


FIG. 1

MACHINING techniques will cut man-hour requirements in half every 10 years.



How the Navy gives its Jet Cadets a leg up

T-28's jet cadets can remove more flight training in less time than ever before in history thanks to the most efficient jet trainer ever devised. It is the T28 Mustang, developed for the Navy by the Columbus Division of North American Aviation.

The T28 is built around one idea: the idea of covering all phases of cadet flight training with one airplane so that there is no time lost in becoming familiar with the characteristics of a succession of trainers. From primary flight through carrier indoctrination, the Navy is now able to train pilots for Mach 3 aircraft in the same time that it took to train them for the 300 mph aircraft

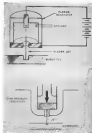
of World War II. And so it more safely.

T28 statistics: top speed 300 mph, landing speed 85 mph, dives safely at Mach 3.85. Ceiling 40,000 ft, range 800 nautical miles. Jet engine can be removed in 7 minutes, replaced in 20. Electronic systems shield-mounted for prompt replacement, A/C consoles on one side, DC as other. Recoil-extended seat ejection functions from deck level to any altitude, and has already saved lives of naval personnel.

The T28 is the only trainer designed to give Navy pilots the versatile instrument they need to command the Navy's future manned weapons systems.

THE COLUMBUS DIVISION OF NORTH AMERICAN AVIATION, INC.

Columbus, Ohio



PLASMA jet (top) and Small jet (below) machining hold promise for the 1970 period.

conventional process that has just recently been introduced in this country. There is no cutting tool involved in this operation, only a concentrated beam of high energy electrons which vaporizes metal away at the impact point of the beam on the workpiece. Stock removal rates are comparatively low, but the method will work on all materials regardless of strength or other properties. Also, it will do very intricate machining with a very high degree of accuracy. Consequently, says Dr. Mandant, it may well be the forerunner of specialized devices having important application in the intricate precision machining problems entailed in the fabrication of future aerospace vehicles.

• **Electro-discharge machining.** In this operation, the work, piece and tool electrodes are separated by a specially conducting dielectric fluid. Voltage between the two is increased until sparking occurs at the rate of 20,000 to 500,000 discharges/sec. Each spark removes a small piece of material that is swept away in the dielectric, creating eventually a hole equal and large in amount of corner or metal removal. An established commercial process, electro-discharge machining works well on electrically conductive, high strength materials and can produce intricate shapes with no forces on the work piece.

The process is not as fast as electro-chemical grinding but is reported to be five times faster than conventional machining in removing stock from high strength materials such as titanium, cobalt, cobalt and high speed tool steels.

• **Ultrasonic machining.** This now is a commercial process. Although slow in comparison to electrical machining

Narrower...
for a wider range of
product improvement



Featuring a high ratio of O.D. to width, these new MPB high precision bearings were originally designed for use in systems of maximum reliability. Further developed under the MPB policy of working with customers to solve maintenance problems, the thin width instruments have proved ideal for servos, potentiometers, gear drives, meters and other instruments.

In applications like these, a thin width bearing may also function as a motor and vice versa, while the motor bearing serves as the bearing, a motor and vice versa. This saving of space results in widely varied product improvement. For example, one 1/2" power servo can use the longer strokes or rotors without increasing overall length or diameter, thus gaining increased power from the same space.

You can produce any size exceptional, perhaps anticipated, advantages from the use of MPB thin-width bearings. Here in ultra precision tolerances of ANSI Class 7, they are available in size sizes with O.D.'s from .0150" to .5000" and bores .0015" to .3125". The new thin width instrument bearings are not "Specials", they are as standard as ball without any premium.

An MPB Sales Eng. man will be glad to discuss your application with you. For engineering assistance and/or new bulletins write to: Absolute Precision Bearings, Inc., 11225 Preston Park, Kennesaw, N. H.

MPB helps you
perform miracles in miniaturization



This is SYLVANIA ELECTRONIC SYSTEMS

now serving as
**Government systems managers
for all subsidiaries of
General Telephone & Electronics Corporation**

Offering single source capabilities for integrated
Communications—Data Processing—Electronic Display Systems

Now Sylvania—long experienced in the field of defense systems research, development and production—offers the far more comprehensive yet unified source of systems management and capability. Systems oriented in concept and personnel, Sylvania Electronic Systems now integrates under one direction all the skills and facilities of one of the world's leaders in communications and electronics—General Telephone & Electronics, and its subsidiaries including:

SYLVANIA ELECTRIC PRODUCTS INC. • AUTOMATIC ELECTRIC COMPANY
GENERAL TELEPHONE & ELECTRONICS LABORATORIES INC. • LINCOLN ELECTRIC CO. INC.
GENERAL SYSTEM OPERATING COMPANIES of General Telephone & Electronics
LEITCH ELECTRIC COMPANY • ELECTRONIC SECRETARY INDUSTRIES, INC.

HOW SYLVANIA ELECTRONIC SYSTEMS BENEFITS YOU: Sylvania Electronic Systems makes it possible to obtain complete defense systems of the highest quality, at specified performance, delivered on schedule at competitive costs. When you work with Sylvania Electronic Systems you enjoy the many advantages of:

One Source Procurement • One Source Authority and Responsibility
Quick Response Capability • Efficiency • Planned Accountability • Experience

Communications Systems

SYLVANIA ELECTRONIC SYSTEMS offers skills and experience covering the complete electromagnetic spectrum in the radio of air, space, water, ground. This integrated systems group includes the capabilities of the 32 domestic and international telephone operating companies in the General System. This group offers the most advanced equipment and development capabilities in dial telephone systems, automatic electromechanical and electronic switching systems, central office and terminal equipment, toll and exchange wires, telegraph, and data carrier transmission systems for wire, cable and radio apparatus, microwave relay and satellite radio systems and advanced low detectability and secure communications systems.



Data Processing and Display Systems

Sylvania leadership in digital data processing is typified by its most recent achievement: design and development of MOSING. This solid state, real-time computer will give field armies real-time solutions to many intelligence and reconnaissance problems, almost instantaneous answers to operational problems involving logistics, inventory control, etc. Sylvania has also pioneered in

developing electronically driven electro-optical display equipment and systems. SYLVANIA ELECTRONIC SYSTEMS has systems management and development responsibility for the data processing portion of the Air Force SIMWS program, including new and advanced concepts of 3-dimensional data take-off circuitry and equipment.



Detection and Tracking Systems

SYLVANIA ELECTRONIC SYSTEMS has an advanced capability in high resolution, electronically scanned radar. Example: Sylvania has managed

acquisition and development responsibility for the Army's AN/SPQ-32, a mobile artillery detection, tracking and fire control system.



Intelligence and Reconnaissance Systems

In recent years, Sylvania has developed numerous types of broadband receivers, signal analyzers, and scanning devices across the entire spectrum. Advanced anti-aircraft devices are now under

development. In addition, Sylvania is developing and integrating several other highly classified projects in this area.



Electronic Warfare Systems

Sylvania leadership in electronic warfare is typified by its advances in countermeasures and counter-countermeasures against all known types of electromagnetic radiation. Sylvania

manages the passive defense system for the B-56, and maintains a quick-reaction capability and leading the Army ground-based electronic warfare activities.



FOR FULL INFORMATION on how Sylvania Electronic Systems might be of special service to you, please call or visit Sylvania Electronic Systems, a Division of Sylvania Electric Products Inc., 700 West Main Street, Harrisburg, Pa.

SYLVANIA ELECTRONIC SYSTEMS
Government Systems Management
for **GENERAL TELEPHONE & ELECTRONICS**





When the Navy's first nuclear-powered surface ship—the USS *Long Beach*—joins the fleet she will have a cruise capability of better than 30 knots, with virtually unlimited range and she will be armed with the surface-to-air Talos and Tartar missiles. The most advanced ship of her kind, the "UGN-9" will have the most advanced shipboard missile control component. *Specter*

controls the longer range Taken missile, Amdaqlap, and is the protected below deck station, are the brains of the system. The computer complex, The Sperry Weapon Direction Equipment (SWE), evaluates target threat and decides which missile to fire at the selected target. The Sperry Mk 111 computer reads target position data from the SPG-45, calculates the best missile-to-target flight path, and passes the guidance beam generated by the Sperry SPW-2 Radar. Then it evaluates "kill."

With her combination of speed, range, horsepower, and advanced Sperry fire control and navigation equipment, the USS *Ward* will make a formidable argument for never being out of the fleet.

methods, it offers the advantage of working on non-conductive materials as well as on those that are conductive. Also, a work cell can handle materials more delicate to ultrasonic machining are a shaped tool and an abrasive slurry. The surface of the tool is vibrated at high frequency and low amplitude and drives the slurry at the work piece. The slurry rocks particles out of the work piece, following the pattern of the slurry force or shaped tool itself.

For the future, two machining methods that now appear to hold much promise are the plasma jet and the high velocity liquid jet. While it is still too early to evaluate these techniques, Dr. Neelkhan and others believe that they must inevitably stimulate to explore the full potential they offer as themselves or as forerunners of new machining methods for the 1975 period and beyond.

The plasma jet basically is a highly ionized stream of ions. An arc is struck between an anode and a cathode. The fluid, gas or liquid, surrounding the electrodes is ionized and is drawn into and across the arc. The arc then forces the current flow into a narrow focus in the center of the arc. In effect, the fluid also serves as an insulating and shielding layer around the constricted arc. fluid is not evaporated. The plasma jet is used to cut metals and nonmetals, and to weld metals and nonmetals. As it enters, the plasma jet is at temperatures above 10,000°K, sufficient to vaporize and melt known material. The jet cuts through metal plates rapidly and smoothly. The plasma jet is used in a number of industrial flow cutting. As a cutting (and plasma) tool, the plasma jet is already being marketed by Linde Co., a division of Union Carbide. But this technique is believed to have a much wider range of applications, and will be used in its present application.

The high velocity liquid jet still is in the early exploration stage, in a mechanical approach that appears to have promise for machining non-conductive materials, particularly the composites. Scientists, following the lead of erosion in the effects produced by sandblasts on high speed steels, have demonstrated that water jets of supersonic speeds against high strength steel will jet and erode the metal. The question, says Dr. Mischke, is whether the rate of metal removal can be used to a non-machined metal level by, say, injecting disease into the water jet.

In estimating an underlying method, the rate of stock turnover is generally accepted as the most important parameter. This relates directly to overhead and labor costs. More specifically, a

Pacific's

are rugged
and right!



Sendoff! Last season's edition of *Parade* is back—and returns 2% stronger than ever—plus 1,000 songs. Features more than 100 drawings by award-winning artists and includes a complete *Parade* 1999 calendar! \$10.95 (57% off \$29.95) www.parade.com



lip increased viscosity by 1% at low shear suggests a nonmonotonic condition. Originally designed for medical applications to reduce the risk of embolism, this poly(ethylene terephthalate) compensated pumping mechanism using silicon fluid



Pacific

PACIFIC SCIENTIFIC COMPANY
P.O. Box 23005, Los Angeles 22, California
Tel. Pasadena • Telex • San Diego
Pasadena • Irvine • Anaheim • Torrance
Representatives: Calchem Co., Los Angeles • Co
Carrington, Northridge, Calif.



30

100:1
miniaturization
with
SOLID CIRCUIT*
semiconductor networks

Solid-Circuit networks are a major departure from conventional components because they integrate oscillator, amplifier, diode, and transfer functions into a single, high-purity, nonconductor wave. Protection and packaging of discrete elements is eliminated, and contacts between dissimilar materials are minimized, reducing element interconnections as much as 80%. Fabrication steps have been reduced to one-tenth those required for the same circuit function using conventional components.

If you need to reduce equipment size and weight—so to design a more complex system in the same size—how? Type Solid Circuit networks for your needs, install, space vehicle, and other microelectronic programs. TI engineers are ready to custom design this concept to your requirements. Contact your nearest TI Sales Engineer today. The TI Type 282 Solid Circuit network is immediately available for your evaluation.

The concept of a *semiconducting network* is the relation of conducting paths in a semiconductor to the desired circuit elements, establishing an orderly design approach based on circuit knowledge. In this manner, semiconductor networks may be designed to perform the functions of a wide variety of existing circuits. Through the proper selection and shaping of semiconductor conductance paths, it is possible to realize such electronic functions as amplification, pulse formation, switching, attenuation, and modulation.



TEXAS 

While these new machining developments are of value to many industries, their greatest importance is generally agreed to be for the aircraft and missile fields, where the number of fabrication problems are getting bigger as the production run shrinks. This is the advantage of the work in future

The outlook for continued improvement in marketing methods here is a optimistic one. Beginning with powerlooms in 1833, Dr. Merriam points out, the trend of machine requirements has moved steadily downward. From approximately 1935 on, required man-hours have been cut in half every 10 years and shows no sign of leveling off.

electrical

—*Yoshiaki Tsukamoto*

Able Star Propulsion System Prepared for Firing

Aircraft-General technicians prepare the Mile Star propellant system in hot lining at the company's Liquid Rocket Plant, Sacramento, Calif. The liquid-fueled second stage was used with the Thor missile to orbit NASA's Navy Taurus satellite. Mile Star is the first propellant system to transfer oxidizers and fuel, and to operate with remote control.

Source for Excellence in
Building, Design, Storage and Cost Win

Three generations of ARMA computers
THE SECOND GENERATION

FOUND!

an intellect
that can think
anywhere

The systems of tomorrow will require digital computers that can think anywhere—intellects that will remain superior in any environment.

ARMA—already producing tactical guidance systems for the ATLAS ICBM—has accepted the challenge and developed a lightweight, second-generation digital computer applicable to all types of navigation. It can be used in space, atmospheric, surface, subsurface and ground navigation, making possible programming flexibility.

This all-solid state computer, with no moving parts and using silicon semiconductors exclusively, has a memory that is non-volatile and has non-destructive readouts. And this computer has substantially fewer parts than ARMA's first-generation production model, which has a test performance unequalled by any other digital computer.

This all-solid state computer, with no moving parts and using silicon semiconductors exclusively, has a memory that is non-volatile and has non-destructive readouts. And this computer has substantially fewer parts than ARMA's first-generation production model, which has a test performance unequalled by any other digital computer.

An even more sophisticated third-generation computer, surpassing the reliability of the first two with still less weight, will be produced in the future by ARMA. The reliability of all three generations will be assured by thorough testing in ARMA's environmental facilities—the most complete in the industry.

ARMA, Garden City, N. Y., a division of American Bosch Arma Corp., the future is our business.

Attention, Engineers: Write to E. G. Gordon, Eng. Dept., about career openings in R & D programs.
AMERICAN BOSCH ARMA CORPORATION



Atlas Agenas test flights will be fired from this pad, complex at Navy's Pt. Arguello Pacific Missile Range facility.

Atlas Agenas Will Be Fired From Pt. Arguello

Work is being completed on a launch pad complex at U. S. Navy's Pt. Arguello, Calif., facility for ground firing of the Atlas Agenas vehicle for Nike-Suborbital ballistic missile early warning system and various advanced reconnaissance system intelligence projects. Navy facilities, part of Pacific Missile Range, is located adjacent to and south of Vandenberg AFB. Launch complex consists of two guideway and pads, at most adjacent to those used for the open-topped Corvus Atlas K304 Complex, on Navy property, is under operational control of U. S. Air Force. An attempt to launch Atlas from Complex 1 with a probe orbit will be made here later this year.

Navy spokesman at Pt. Arguello said that the facility also is the site for Project Sea-Base launches to study the effects of solar flares (AV Apr. 4, p. 26) and for upper atmosphere sounding rocket flights for Atomic Energy Commission's Project Tumblerwest. Flights for Project NEKV (nuclear energy remote vehicle) also are scheduled to be made from the site. NEKV vehicle is a three-stage, solid propellant rocket which will reach altitudes of 1,200 mi. and travel 1,200 mi. downrange, where an attempt will be made to recover the nose cone. Pacific Missile Range, of which Pt. Arguello is a part, will have overall responsibility for flights.

Major site also is being built to high altitude complex rocket on its launchers.



How to take a longer look at air space



Tomorrow's manned interceptor aircraft—and even faster ones of the future—require radar navigation, target acquisition, armament control and electronic counter-measures systems of vastly greater scope and dimension than ever before.

To fulfill this critical requirement Hughes has developed a new advanced radar system which embodies many significant state-of-the-art advances. One of the most significant is a unique and highly advanced Traveling Wave Tube developed in the Hughes Laboratories. This tube's two outstanding advantages: 1) higher power to provide greater range, 2) broader frequency band width for operational flexibility.

In addition, this new Hughes radar system will discriminate against ground returns and will detect targets at extreme ranges. Designed to operate as a "hard" counter-measures environment, the system is radar augmented by infrared detection and tracking.



Heart of the new Hughes radar system is this Traveling Wave Tube which provides greater power and a broader band width.

One of the vital "memories" of the new Hughes system is the miniatured (14 cu. ft.) Hughes memory drum which can store over 1 million bits of information.



This radar system is the latest of a series of pioneering Hughes systems. The Hughes E-1 was the first all-weather interceptor radar system ever developed. The Hughes E-4 system first made possible the rocket lead-collision attack. The Hughes E-8 and H-8 series systems were first to automatically align and fire advanced air-to-air guided missiles. And the Hughes MA-1 system first provided complete control of aircraft from take-off to touch down.

Although over 35,000 all-weather interceptor systems have been produced to date, Hughes' radar experience is not limited to interceptor systems. For the Army and Navy, Hughes is producing surface-based 3-dimensional radar systems which utilize electronics, rather than mechanical scanning methods. And the Hughes TARAN system utilizes a high-resolution radar which makes it possible for pilots to fly tactical maneuvers at low altitudes, in any kind of weather!

Fulfilling the needs of the future—and being the first to provide for them—is a deeply ingrained tradition at Hughes. Perhaps we can help you solve some of your radar system problems. Please write: Hughes Advanced Program Development, Marketing Department, Hughes Airborne Systems, Culver City, California.

Dressing a new world with **ELECTRONICS**

HUGHES

MEMBER AIRCRAFT COMPANY
Culver City, El Segundo, Fullerton, Newport Beach,
Malibu, Torrance, Los Angeles, Calif.; Houston, Texas.

WHY YOU SHOULD PROGRAM YOUR TESTING THIS BETTER WAY

WITH EECO's UNIQUE 80-BIT BI-DIRECTIONAL PUNCHED TAPE PROGRAMMER

For automatic programming of test equipment, the EECO TP-201A offers these decisive advantages over stepping switches or single-line 8-bit programmers:

- (a) Far more elaborate programs can be automated...up to 240,000 bits per reel, presented at 80 bits per step. (b) Random or sequential access to any of the 3000 frames on each 250-foot tape. (c) Provision for visual selection of program steps. (Printed information on tape correlates with punched information). (d) Reduced testing time and skill requirements for tape punch personnel. (e) Programs can be stored and re-used. (f) Small size panel is 6"x11 1/2", depth below panel 5 1/2".

Tough Mylar tape contributes to improved reliability. No special punch needed. Bi-directional electrical drive systems. Positive detent action for accurate positioning of tape.

Other models available for automatic programming, precision control, and precision time base programming. Write for data sheet.



Electronic Engineering Division
Electronic Engineering Company of California
1801 Ben Chabert Ave. - Santa Ana, Calif. - (714) 765-5600 • TRS: 8 ANA 1863

WE CAN BE YOURS IN A VARIETY OF BUSINESS SITUATIONS • SPECIAL ELECTRONIC EQUIPMENT • SPECIAL ELECTRONIC EQUIPMENT



Joint R&D Effort Made On Hybrid Rocket

Grand Central Rocket Co. and its Marquardt Corp. are conducting a joint research and development program on the hybrid rocket motor. The company-funded program is concentrated on the development of a high-performance, flexible propulsion system that combines two of the solid and liquid fuels.

Grand Central has cut 32 solid propellant hybrid motor and transported them to Marquardt where they were combined with the liquid oxidizer and successfully test fired. The hybrid motor combination consists of three major parts:

- Liquid oxidizer storage tank.
- Solid propellant grain.
- Ignition throttling device.

Gas is transmitted under pressure to the liquid oxidizer storage tank. The stored oxidizer flows from the storage tank into the combustion chamber, combining here with the solid propellant grain and burning of the solid propellant grain in the chamber.

An efflux control system regulates flow of the liquid oxidizer through thrust and sustains combustion of the motor to be controlled.

SAC Fires Atlas ICBM From Horizontal Pad

Vandenberg AFB, Calif.—Operational Atlas intercontinental ballistic missile has been fired as the first Strategic Air Command missile having launch to be conducted from a horizontal storage pad.

The storage pad resembles a coffee can with a cylindrical shaped concrete building with a steel sliding roof.

The Atlas ICBM was launched by a SAC crew from a Vandenberg-based crew of residence who will soon be the 18th SAC Mission Sqds at Fairchild E. Warner AFB, Clovis, N.M. This unit also was the first to employ the retired MOD III missile control pad and missile which will be used in horizontal launch complex.

Rocketyne Has Achieved Controlled Thrust Motor

North American Aviation's Rocket Division at Chgo., Tex., has achieved controlled thrust variation of a solid propellant motor motor in a company-sponsored research program. Experiments with the division's solid propellant grain have designed and test fired a new controllable motor that electrically varied the thrust of a solid propellant motor 70%. Thrust was first lowered then increased over the approximate range of 70% to 110%.



FOR THE AIR FORCE, MSVD engineers test three-axis stabilization system using simulated Sun. Similar system will accept stabilization capability in use of U.S. communication satellites.

**MISSILE AND SPACE
VEHICLE
DEPARTMENT**

...center for missile and space technology research
and development at General Electric

Progress in space vehicle navigation

As space vehicles probe further and further away from the Earth, and as their missions become more and more complex, the need for accurate, high-precision space navigation and control becomes increasingly vital.

General Electric Missile and Space Vehicle Department engineers are now developing and testing space vehicle control equipment for the 24-hour-orbit communication satellite program. They have already designed and flight-tested on space vehicles a three-axis stabilization system as well as orbit computation and correction techniques. Using the Earth and Sun as reference points, this MSVD three-axis system successfully controlled the attitude in space of U.S. A.F. Atlas and Thor re-entry vehicles during a major portion

of their ballistic flights. The control accuracy attained on these flights could be duplicated on flights further into space, using other planets and stars as check-points.

For more information about MSVD's space navigation and control work for the Air Force and its other contributions to U.S. space technology programs, write to Section 180-70, General Electric Missile and Space Vehicle Department, Philadelphia 4, Pennsylvania.

GENERAL ELECTRIC

MISSILE AND SPACE VEHICLE DEPARTMENT
A Department of the Defense Electronics Division

Scientists and Engineers interested in career opportunities in Space Technology, contact Mr. T. H. Johnson, MSVD

Report on Developments of

New Fansteel 82 Metal in Hypersonic Vehicle Prototypes

Design and development work on hypersonic flight vehicles by Boeing Airplane Company and other missile and aerospace manufacturers has indicated some important considerations for Fansteel 82 Metal. This new molybdenum-titanium-niobium alloy was among the materials fabricated into prototype leading edges for missiles, capable of withstanding at 2000°F and over. Results verified Fansteel's own tests proving the metal's high strength-to-weight properties at elevated temperatures.



Excellent Oxidation Resistance
Extensive tests in the Fansteel laboratory prove Fansteel 82 Metal has superior oxidation resistance to pure columbium. Calculated on the basis of weight gain

during exposure at 2000°F in air, 82 Metal is ten times as resistant as the pure refractory metal. Six tests have, 2000°F test on flowing air showed remarkable low and low of 0.00 cm.

Tensile Properties of Sheet
The encouraging results of Boeing's prototype tests indicate 82 Metal's suitability for extreme and stable control. Average tensile properties are shown below.



Fansteel 82 Metal Easily Formed
In addition to its high temperature properties, 82 Metal has excellent formability characteristics. Double width can be made with little or no tendency to distort after heat affected zones. It is easily fabricated or annealed, its casting



Bending the leading prototype in an inert atmosphere chamber using nitrogen gas jet process.

point is 4500°F and density 10.36 grams per cc (0.375 lb. per cu. in.)

Design and Engineering Help
Fansteel engineers and metallurgists are now working with many other firms in adapting Fansteel 82 Metal to specific needs. They will be glad to cooperate with your own designers and production people in studying and applying this useful new metal. Just send us your print or just sample, or send in the Fansteel representative.

Available From Stock

For experimental purposes... Fansteel 82 Metal is available from stock in ingots, forgings, bar, rod, plate and sheet. Get us keep you informed of developments concerning this new alloy as they occur. Write for the latest technical bulletin.

TENSILE PROPERTIES OF SHEET

TEMPERATURE Degrees F	ATMOSPHERE	ULTIMATE TENSILE STRENGTH psi	YIELD STRENGTH psi	ELONGATION % in 1 in.
20-82	Air	75,000	45,000	32
1650	Argon	55,000	35,000	1.5
2450	Argon	25,000	15,000	34

Product Division of Boeing Airplane Company



FANSTEEL METALLURGICAL CORPORATION
NORTH CHICAGO, ILLINOIS, U.S.A.

AERONAUTICAL ENGINEERING



CONSTRUCTION of all-glass fiber rotor blades, rather than glass fiber ribs which are spread about 3 in. apart and have 8 in. diameter top and bottom to pick up thin glass fiber skin. Servo Motor used to change rotor blade pitch will have similar glass fiber construction.

First Glass Fiber Rotor Blades Tested

By Michael Yaffee

First all glass fiber rotor blades will be flying within a year, most likely on an U-2 or U-10. Other aircraft companies expected to follow shortly are the Kaman H-15 Vertol H-15 and the Bell H-40 helicopter.

Parsons Corp., maker of the U-2, Bell and Vertol rotors, has been working on glass fiber blades for some time and is now for flight production. Kaman has been working on its all-glass fiber rotor blade for a year and says that it could start producing prototype units within another year. Sikorsky, on the other hand, which has made and tested glass fiber blades in the last year and a half, plans to stay with its aluminum rotor. Sikorsky is finding increasing use for the glass fiber in other, non-rotational applications where the loads are non-cyclic, such as the helicopter's auxiliary frame, and is experimenting with the use of glass fiber in the tips and trailing edges of its all-aluminum rotor.

Expected Advantages

Expected advantages of the new glass fiber rotor blades are lower cost, lighter weight and longer life. The latest step in an evolution that has seen the growing replacement of wood and metal rotor blade components by reinforced plastics, the new blades now use reinforced plastic for structural as well as non-structural members, from root to tip, except for the rubber or steel aluminum strip on the leading edge, preventing the glass fiber from rime erosion.

Parsons' rotor will also use a metal plate on the root end where the blade attaches to the hub.

Successful demonstration of the use of plastics in structural rotor applications, where the rotating nature is the highest of these in use, cannot structural member, has opened the door to the use of plastics in other parts of the helicopter. Kaman's chief engineer, Norman Stone, believes that long all-fiber plastic rotor blades will be competitive with those

now made from steel metal. Stone admits that it is still too early to determine the probability of making large plastic rotors as a production item. Most engineers feel that it will not prove feasible.

Production Problems

Chief drawback to production of plastic components is the hard-to-cure material. Each unit must be an up to heat on individual molds and cured. There is little opportunity to take ad-



THICK-WALLED root end of Kaman's all-glass fiber rotor blade is reinforced top and bottom with glass fiber checkplates. Holes are for the gap retention bolts. Blade radius is 215 ft.



Helping to guarantee a vital
"something" for a rainy day



The effectiveness of America's defense "umbrella"—today and tomorrow—depends on instant availability of superior electronic weapons.

For over seven years, the Hallicrafters company has been answering this urgent need with QRC—Quick Reaction Capability.

For your electronic requirements . . . from single circuit to complete system . . . for application on land, sea, air or space . . . Hallicrafters QRC can provide you with this unique design and production service in electronics.

ENGINEERS. Join our rapidly expanding QRC team now. For complete information address your inquiry to: William K. Prockter, Director of Engineering.

hallicrafters  **company**
MILITARY ELECTRONICS DIVISION CHICAGO 24, ILLINOIS

URGENT PROBLEMS RELIABLY SOLVED

usage of the benefits offered by high speed, highly automatic machining. On the other hand, as Stone points out, helicopter production will require more manual operations. When not chasing or dodging of glass fiber components is necessary, the resulting dust also presents a problem. The workers must wear masks for protection against dusts, provide them with given hair nets and headsets such as shower hats for this work.

More important than the dust problems are the processing pitfalls to be avoided.

Chief among these, according to Process engineer John Cannon, are the selection and application of the glass fibers from the thousands of types available, the selection and timing of the heating rates, and finally the problem of maintaining structural uniformity from one layup to the next. Also, although not a disadvantage, the plastics do not offer any advantages in raw material cost.

Advantages

Glass fiber rotor blades do offer numerous and significant advantages compared with present metal and wood blades, chiefly for outweighing the materials drawbacks, says Kauter.

Most important of these are the following:

- **Less weight.** Glass fiber rotor blades are expected to be about 20% lighter than comparable present blades. This should result in a gain of 4.5 hp which can be used to increase payload, speed and altitude performance. On a strength to weight basis, according to the comparison, glass fiber is better than aluminum, magnesium, titanium, steel and even the honeycomb structures now used in some rotor blades.

- **Lower cost.** Primarily as a result of savings in development time and testing costs, glass fiber blades are expected to cost 10% or more under present blade costs. During development, for example, modifications can be made quickly simply by laying on additional glass fiber cloth. Long cycles for new mold expansion turning and extrusion then used in fabricating aluminum blades are unnecessary.

- **Longer life.** Owing to their greater resistance to fatigue, chemical corrosion and fading, glass fiber blades will have a longer useful life than most current blades, says Stone.

- **Greater safety.** Every strand in a glass fiber cloth acts as an independent load carrying unit. When fatigue occurs, a few strands may break, but there is not an immediate failure of adjacent fibers, then, as in wood or metal structures.

- **Easier inspection.** Before glass fibers fail, few things enter. A complete visual inspection can be made while the

RACK-AND-PANEL CONNECTORS THAT ARE SELF-ALIGNING



The Deutseh Company
ELECTRONIC COMPONENTS DIVISION
Whittier Airport • Whittier, California

TAPCO POWER SYSTEMS



MINIAPS

solid-fuel turbogenerator weighs only 4½ pounds

This miniature solid-fuel turbogenerator was developed within 4 months by TAPCO for such functions as firing, actuator and guidance. It is a compact, lightweight, self-contained and self-regulated secondary power system. It operates reliably in temperature ambient from -65° to $+160^{\circ}$.

MINIAPS uses hot gas generated by solid fuel to power a turbine that drives an electric generator of 60,000 rpm. Turbine and generator are on a single shaft. Five outputs of AC and DC are produced, with AC frequencies strictly governed by transistorized speed controls.

The version pictured weighs only 4½ pounds, yet produces 60 watts of power for 90 seconds duration. Other versions produce up to 200 watts. Duration of output can be varied by increasing or decreasing size of propellant grain.

TAPCO's many years of experience in the design and manufacture of turbo-motors was an important factor in the development of MINIAPS. Other TAPCO power systems, now operational or under test, include classical missile APU's, hydraulic actuators, hot-gas actuation systems, solar and nuclear systems, solid-fuel and hydraulic gas generators, and re-entry turbines.



TAPCO GROUP
Thompson Ramo Wooldridge Inc.

Dept. JMW-800 • Cleveland 17, Ohio

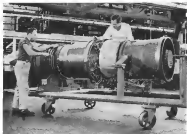
DESIGNERS AND MANUFACTURERS FOR THE AIRCRAFT, SPACE
AND GUIDANCE ELECTRONIC AND NUCLEAR INDUSTRIES

MINIAPS is only slightly larger than
a beer can. It is shown here actual
size: 2½" x 3½" x 3½".

Navy Tests A2F Low-Level Attack Bomber



A2F-1 INTRUDER. Grumman's 37th combat model, has flown from 30 ft. (left) to Mach 9 at sea level. Empty weight is 24,000 lb. Maximum gross weight is 54,000 lb.



POWERPLANTS for the A2F-1 consist of two Pratt & Whitney JTF6 turbojets (above), each delivering 8,500 lb. thrust. Variable tailpipes (below) can be lowered 30 deg. for STOL effect during takeoffs and landings. Pattern speed approximately 105 ft.



Calverton, N. Y.—Grumman's new side-by-side two-place, tailless A2F-1 Intruder, the 37th combat model the company will deliver to the Navy, is a combat-ready low-level attack bomber capable of sustaining Mach 9 at sea level (AW May 2, p. 31).

The A2F-1, a wing-wing long-range aircraft, is powered by two Pratt & Whitney JTF6 turbojets, each of which delivers 8,500 lb. thrust. Variable tailpipes (adjustable) can be lowered about 30 deg. for STOL effect during takeoffs and landings, giving a 104:1 speed reduction under the action.

Navy, which has eight A2F-1s on order, took delivery of the first during ceremonies here Apr. 25th. First aircraft will be delivered this calendar year and four the next, all for test purposes.

The first Intruder made its eighth flight during acceptance ceremonies, at which time it had flown 8 hr.

Slow-flight capabilities were evidenced during a fly-by by Grumman test pilot Robert Smith. Empty weight of the Intruder is 24,000 lb. Maximum gross weight is 54,000 lb. At a dash light weight Smith had the A2F-1 airborne after a roll of approximately 1,200 ft. Retarders speed was reported at 100 ft.

Intruder demonstrated a good rate of climb and a slow-speed, climb, 105-lb. pattern with tailpipes deflated about 30 deg. Flaps have been most effective at 40 deg. extension.

Though optimum speeds have not yet been reached, the A2F-1 has been stalled, clean, at 125 ft. With power, gear and flaps down, the aircraft has stalled at 50 ft. Controls are similar to those of Grumman's F11F-1F.

During static display at Calverton the A2F-1 was fitted with external stores. Three Mark 34, 2,000-lb. GP bombs were mounted outboard on each wing and under the belly. Two Martin ASM-7 Bullpup missiles were mounted inboard on each wing. Armament probably will include the Terrier Cruise XASM-N-8 air-to-surface missile.

Design of the Intruder meets Navy requirements that included capabilities for extended range, low-altitude nuclear missions, including limited head-on war. Completely obscured targets are visually represented to the pilot and radar operator through the aircraft's electronic integrated display system.

The integrated display system also provides data for the A2F-1's digital integrated attack navigation system (DANS).

A2F-1 is being developed under the first "comprehensive" contract totaling \$301,701,000, to be administered by the Navy.

HUMAN FACTORS



FIRST test of a complete life support system was made by Grumman Mettger, during preparation to test flight from a glider system tube at 10 ft. He was observed around the clock during the seven-day test. The complexion, he was greeted (right) by his wife and children.

Hermes Tests Zero-G Capsule Equipment

By Evert Clark

Durham—Seven-day manned test in a small capsule has demonstrated that a life support system capable of operating in the neighborhood of space could be built now, Air Force researchers believe.

Project Hermes, completed recently at Air Research and Development Command's Wright Air Development Division here, was the first combined test of a number of life sustaining subsystems designed and engineered on operating principles that would be valid under zero-gravity conditions.

Hermes also was the longest zero-gravity flight in which a man has remained for seven days in an almost completely self-contained, or "closed," environment.

The project was conducted by what was the Engineering Development Branch of the former Aerospace Models



POOD water (left) from plastic tubes. Plastic sponges in vacuum for (right) distilled Mettger's urine in the recycling system.

Make a new kind of nozzle to steer an inferno?

*We've a
good mind
to do it at*



ALLISON

DIVISION OF GENERAL MOTORS CORPORATION WARREN, MI 48090

Develop a metal or plastic which will withstand some of the highest thermal and dynamic stresses known to man—

Devise a method of applying this material in an absolutely uniform coating on a nozzle throat—

Design a lightweight nozzle strong enough to handle the most reactive thrust—

Decide which seal design will permit the nozzle to vector properly, withstand the tremendous heat and pressure of extremely hot gases.

There are some of the problems which Allison has encountered and is overcoming in designing and producing vectoring nozzles for missiles.

Plasma jets gave us the key to our solution—metallurgical studies uncovered a secret. Polymer research pointed the way to further success—new processing techniques toppled another barrier.

Thus, the state of the nozzle art has been advanced—a serious bottleneck broken. And this is but one of the many areas in which Allison—backed by every resource General Motors possesses—is working in the space age.

Whether your problem lies in the heavens, in the oceans, or on the earth, Allison has the will and—if it can be solved—the way to solve it. We're doing it for others—we could do it for you.

Illustrated is a plastic model of one type of nozzle used as a research tool by Allison scientists and engineers.





When CONTROL cannot be a question of degree . . .

Exact engine control believed impossible only a few years ago is now the expected, not only in modern aircraft and missiles, but also in today's automobiles and trucks. And, this absolute accuracy is demanded under temperature, pressure, and power conditions found, until recently, only in laboratories. Temperature variations alone of -80°F to $+180^{\circ}\text{F}$ require almost continuous compensations in today's jet aircraft and

missiles. More, these ever-increasing requirements must be designed for ever-decreasing standards of size and weight.

For more than a half-century, Holley has pioneered such developments as: lower automotive hood hoods through smaller carburetors and fuel control systems for jet engines that save one-third the weight, one-fourth the space. That's why two generations of Americans on the move have come to depend on Holley products.

For more information about Holley products, automotive or aircraft, write to:

HOLLEY
Carburetor Co.
8752 S. HOME AVE. RD.
WARREN, MICH.

3-20
FOR MORE THAN HALF A CENTURY
ORIGINAL EQUIPMENT MANUFACTURERS FOR
THE AUTOMOBILE AND AIRCRAFT INDUSTRIES

mission inside the capsule be means of the intercommunication box provided for him, but he thought he could be suffering with their work. In one such future test, researchers will attempt to talk frequently to the man in the capsule.

Mitrop's water intake was relatively low for the first few days. Internal temperature and humidity were well within the comfort zone, as Mitrop reported little, but researchers also found that he was worried at first that he might run out of water until they told him that he could drink every two hours without refueling the supply.

The capsule's equipment included a "panic button" that would ring a bell outside, but Mitrop did not use it.

The laboratory branches which worked on Hermes also are working approximately 75 contracts, averaging about \$50,000 per contract, on various components of life-support systems. Several tube tests have led to two contracts for development of materials that will reduce the load to a person. One is a square aluminum container that may have a plunger to push the food forward, and the other a plunger. Although some problems remain in these pressure loads in plastic bags, they save weight over metal containers.

In addition to Mitrop's project personnel included Richard Detroit, animal and water supply unit. By Robert Hayes, animal, refrigeration and flight feeding equipment. Donald Keating, oxygen-generating equipment. Lt. Alvin Hulen, emergency oxygen equipment. Walter Hines, air and gas, ventilation system and communication systems. George Fisher, stabilization systems. Kenneth Weaver, animal for respiration equipment and communication gear and collection of instruments.

PRODUCTION BRIEFING

Loew, Inc.'s, Industrial Products Group has received a contract to produce 10 remotely operated automatic control systems for nuclear reactor being developed by Martin's Nuclear Division. The remotely-operated control rod positioning system will be used in critical tests where fine precision measurements are required. Martin's liquid-fueled test reactor were cited as an application of the system.

Douglas Aircraft Co. is working with Air Force in an extensive aircraft testing program to produce the fatigue life of an airplane. It will provide a basis for engine design of future aircraft. A Douglas C-815 Cargomaster will carry the bulk of the testing workload. Progress includes fatigue analysis and development of load spectrum, re-

actor engine loads, flight test of instrumented aircraft, engine cycle fatigue testing, and according to past data on a fleet of aircraft.

Lycoming Division of Avco Corp.'s T55-L-7 gas turbine completed its 18-in. USAF performance flight testing test one month ahead of schedule. The test was run at an average rating of 2,100 shp, specifications require 1,970 shp guaranteed power. The production T55 is expected to be qualified as engine at 2,200 shp.

Psy Instrument Landing System will be installed at Nairobi Airport, Kenya, Africa. System will be used to bring transport aircrafts to landings by radio guidance on the airport's 11,500-ft runway.

Consolidated Diesel Electric Corp.'s Aircraft Equipment Division will build 55 water-reversing units for the Air Force under a \$3 million contract. The tank units rated 2,600 gal of deaerated water to reverse jet aircraft equipped with water injection engines.

Lockheed Aircraft Systems, Inc., will

handle the American side of the Mads airborne flight recorder. The Mads recorder, developed by Raytheon Instruments, of Englewood, consists of 270 channels of information on magnetic tape with 168 hr capacity. The data tape, 3-in. wide, equipped with a float and a hovering beacon, is ejected in the event of a crash.

Hamilton-Standard Division of United Aircraft Corp., Windsor Locks, Conn., will build 160 mobile postal towers and 33 infrastructure electronic shops under \$2.5 million Air Force contract. The two-story steel unit vans, measuring 5 ft. square by 5 ft. high, will be used by the Tactical Air Command at temporary landing fields.

Standard Railway Equipment Mfg. Co., Chicago, is transferring production of export terminal loading systems from its P. I. Steel Corp., Los Angeles to the company's Ogden, Utah, facility, due to increased production demands. Current backlog of the telescoping "jetway" vehicles is 35 including 14 slated for United Air Lines.



B-58 escape capsule is ejected from old at over 700 mph. at Homestead AFB, Utah.

B-58 Escape Capsule Test

Research begins to refine the General Electric B-58 Hustler jet bomber escape capsule system is under way at Standard Aviation Corp., Denver, Colo., under contract from General Dynamics of General Dynamics. The capsule is shown at right, and is ejected by a ballistic charge, suspended in the power of a 37 mm cannon shell and then a rocket motor on the capsule itself automatically to push the capsule and air unit further away from the aircraft. For study capsule automatically to lower the capsule to the ground. Stanley Aviation and football players to run tests of actual shock forces through instrumentation. Findings show football players withstand load forces of upward of 7g without injury.





EXTEND PERFORM

ously processed to per-
formance obtained
2.2 MW L-Band Klystron
3,000 hours. Some at
operating for more than
The Skatron tech-
ature even broader-ban-
ranges. Should you re-
(L-3270 is available
Electron Tube Division

**A technique developed by*



LIT
LAMP
TUBE
CORPORATION
CHICAGO

CAPABILITY

The Skatron technique is being applied to other tubes now being developed to obtain even broader-band performance at higher power levels and in other frequency ranges. Should you require high power broadband performance for your current (L-3270 is available now) or future system planning, write to Lemon Industries, Electron Tube Division, Office A13, 960 Industrial Road, San Carlos, California.

*A technology developed by Zinus Industries which provides improved broadband performance

LITTON INDUSTRIES Electron Tube Division
 MAGNETRON • RECTIFYING TUBES • MAGNETRODES • KLYSTRONS • TRAVELING WAVE
 TUBES • BACKWAVE WAVE OSCILLATORS • GAS DISCHARGE TUBES • X-RAY ROENTGEN
 CROOKS FIELD AMPLIFIERS • HIGH DEPOSITION CRT • DIRECT READING CRT
 COLOR CRT • STORAGE TUBES • PHOTOGRAPHIC FILMS • OSCILLATORS • TR TUBES

CAPABILITY I CHANGE UR PLANNING

McDonnell Is Optimistic on Future

The probable success

• **Optimism on the part of McDonald:** To many analysts, he seemed to be the last survival company president to look and talk optimistically before the society in the last six months.

- Market survey will be made internationally to determine the executive airplane sales potential of the Model 220. This is McDonnell's Model 319 airplane, transport built for a USAF competition but equipped with General Electric CF700 jet engines.

McDonald's stock has sold below book value at times during the last year, and McDonald's has bought back about 3,000 shares. Through this paper, and through an auction or influenced shares less 2,000,000 to 2,000,000 shares for a two for one stock split, McDonald's hopes to add to shares held in the company treasury for use as possible acquisitions.

Dallas, Tex.—Net income of \$375,490, after federal income taxes, was reported by Trites Aircraft Co., Dallas, for the first quarter of 1960. Net earnings for the same period last year were \$267,150.

Sales for the first quarter of 1983 totaled \$19,172,729, compared with sales of \$28,142,365 in the same period last year. Women's business a-

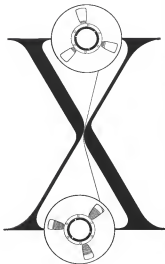


Model 500A Acro Commander Makes First Flight

Also Commander 300A, first of a new series of Aero Commanders being produced by Aero Design & Engineering Corp. (AWA) 1000 N. 11th, Milwaukee, Wis. Available in 1000, 1200, 1400, 1600, 1800, 2000, 2200, 2400, 2600, 2800, 3000, 3200, 3400, 3600, 3800, 4000, 4200, 4400, 4600, 4800, 5000, 5200, 5400, 5600, 5800, 6000, 6200, 6400, 6600, 6800, 7000, 7200, 7400, 7600, 7800, 8000, 8200, 8400, 8600, 8800, 9000, 9200, 9400, 9600, 9800, 10000, 10200, 10400, 10600, 10800, 11000, 11200, 11400, 11600, 11800, 12000, 12200, 12400, 12600, 12800, 13000, 13200, 13400, 13600, 13800, 14000, 14200, 14400, 14600, 14800, 15000, 15200, 15400, 15600, 15800, 16000, 16200, 16400, 16600, 16800, 17000, 17200, 17400, 17600, 17800, 18000, 18200, 18400, 18600, 18800, 19000, 19200, 19400, 19600, 19800, 20000, 20200, 20400, 20600, 20800, 21000, 21200, 21400, 21600, 21800, 22000, 22200, 22400, 22600, 22800, 23000, 23200, 23400, 23600, 23800, 24000, 24200, 24400, 24600, 24800, 25000, 25200, 25400, 25600, 25800, 26000, 26200, 26400, 26600, 26800, 27000, 27200, 27400, 27600, 27800, 28000, 28200, 28400, 28600, 28800, 29000, 29200, 29400, 29600, 29800, 30000, 30200, 30400, 30600, 30800, 31000, 31200, 31400, 31600, 31800, 32000, 32200, 32400, 32600, 32800, 33000, 33200, 33400, 33600, 33800, 34000, 34200, 34400, 34600, 34800, 35000, 35200, 35400, 35600, 35800, 36000, 36200, 36400, 36600, 36800, 37000, 37200, 37400, 37600, 37800, 38000, 38200, 38400, 38600, 38800, 39000, 39200, 39400, 39600, 39800, 40000, 40200, 40400, 40600, 40800, 41000, 41200, 41400, 41600, 41800, 42000, 42200, 42400, 42600, 42800, 43000, 43200, 43400, 43600, 43800, 44000, 44200, 44400, 44600, 44800, 45000, 45200, 45400, 45600, 45800, 46000, 46200, 46400, 46600, 46800, 47000, 47200, 47400, 47600, 47800, 48000, 48200, 48400, 48600, 48800, 49000, 49200, 49400, 49600, 49800, 50000, 50200, 50400, 50600, 50800, 51000, 51200, 51400, 51600, 51800, 52000, 52200, 52400, 52600, 52800, 53000, 53200, 53400, 53600, 53800, 54000, 54200, 54400, 54600, 54800, 55000, 55200, 55400, 55600, 55800, 56000, 56200, 56400, 56600, 56800, 57000, 57200, 57400, 57600, 57800, 58000, 58200, 58400, 58600, 58800, 59000, 59200, 59400, 59600, 59800, 60000, 60200, 60400, 60600, 60800, 61000, 61200, 61400, 61600, 61800, 62000, 62200, 62400, 62600, 62800, 63000, 63200, 63400, 63600, 63800, 64000, 64200, 64400, 64600, 64800, 65000, 65200, 65400, 65600, 65800, 66000, 66200, 66400, 66600, 66800, 67000, 67200, 67400, 67600, 67800, 68000, 68200, 68400, 68600, 68800, 69000, 69200, 69400, 69600, 69800, 70000, 70200, 70400, 70600, 70800, 71000, 71200, 71400, 71600, 71800, 72000, 72200, 72400, 72600, 72800, 73000, 73200, 73400, 73600, 73800, 74000, 74200, 74400, 74600, 74800, 75000, 75200, 75400, 75600, 75800, 76000, 76200, 76400, 76600, 76800, 77000, 77200, 77400, 77600, 77800, 78000, 78200, 78400, 78600, 78800, 79000, 79200, 79400, 79600, 79800, 80000, 80200, 80400, 80600, 80800, 81000, 81200, 81400, 81600, 81800, 82000, 82200, 82400, 82600, 82800, 83000, 83200, 83400, 83600, 83800, 84000, 84200, 84400, 84600, 84800, 85000, 85200, 85400, 85600, 85800, 86000, 86200, 86400, 86600, 86800, 87000, 87200, 87400, 87600, 87800, 88000, 88200, 88400, 88600, 88800, 89000, 89200, 89400, 89600, 89800, 90000, 90200, 90400, 90600, 90800, 91000, 91200, 91400, 91600, 91800, 92000, 92200, 92400, 92600, 92800, 93000, 93200, 93400, 93600, 93800, 94000, 94200, 94400, 94600, 94800, 95000, 95200, 95400, 95600, 95800, 96000, 96200, 96400, 96600, 96800, 97000, 97200, 97400, 97600, 97800, 98000, 98200, 98400, 98600, 98800, 99000, 99200, 99400, 99600, 99800, 100000, 100200, 100400, 100600, 100800, 101000, 101200, 101400, 101600, 101800, 102000, 102200, 102400, 102600, 102800, 103000, 103200, 103400, 103600, 103800, 104000, 104200, 104400, 104600, 104800, 105000, 105200, 105400, 105600, 105800, 106000, 106200, 106400, 106600, 106800, 107000, 107200, 107400, 107600, 107800, 108000, 108200, 108400, 108600, 108800, 109000, 109200, 109400, 109600, 109800, 110000, 110200, 110400, 110600, 110800, 111000, 111200, 111400, 111600, 111800, 112000, 112200, 112400, 112600, 112800, 113000, 113200, 113400, 113600, 113800, 114000, 114200, 114400, 114600, 114800, 115000, 115200, 115400,

NO DOUBT ABOUT IT—

"SCOTCH" BRAND Sandwich Tapes
wear 10 times as long without errors



IN THAT NARROW LITTLE LETTER OF DATA known as magnetic tape, a zero is engraved into a hole. A record life, or time pulled up by error in coding, frustrating and time-consuming. If you're in doubt about the kind of performance you're getting, perhaps "SCOTCH" BRAND Sandwich Tapes can solve some of your tape and equipment problems.

The exclusive construction of the Sandwich Tapes eliminates the causes of error because it eliminates the source—oxide rub off and head build-up. Tests prove it wears a minimum of 10 times as long as ordinary tapes before it errs. As a by-product, you can rely on it to drastically reduce maintenance and replacement costs on equipment.

The Sandwich is constructed as shown in the diagram at the right. The (newer "SCOTCH" BRAND high potency oxide coating is sandwiched between a tough polyester base and a 50 micron-thick layer of plastic. Since the oxide is never in contact with the head, tape movement is smooth and low is friction—easy on both tape and equipment. Oxide can't rub off and doesn't valuable data.

Yet, the real test of this remarkable Sandwich is the "SCOTCH" BRAND high potency oxide coating. Even under the protective plastic, the oxide's potency is quite sufficient to pick up 500 pulses per inch—and give desirable high-frequency response in many AM, FM and FDM applications. Sandwich Tape is not one of the developments in come out of 3M research—the same research responsible for "SCOTCH" BRAND Video Tapes—the first video tape in commercial use.

Whatever your application—you'll find the right tape for reliable, error-free performance in the "SCOTCH" BRAND line-up. Check them all: High Resolution Tapes 155 and 159 pack more bits per inch, offer after standard or extra-play time. New Heavy Duty Tapes 198 and 199 offer good resolution and exceptional life even in poor environments. High Output Tape 228 gives top output in low frequencies, even in temperature extremes. And Standard Tapes 108 and 109 contain the standard of metrocentricity.

Your 3M Representative is close at hand in all major cities—a convenient source of supply and information. For details, consult him or write Magnetic Products Division, 3M Co., St. Paul 6, Minnesota.

© 1968 3M Company

SCOTCH BRAND MAGNETIC TAPE
FOR INSTRUMENTATION

3M Company and Magnetic Products Division
...THE 3M BRAND IS A MARK OF QUALITY



Mar 31, 1968, totaling \$30 million in orders letters of intent and contracts being negotiated. Company is also causing a merger with Ling-Mac Electronics (AW Mar 2, p. 37).

Tosco also has a preliminary draft of Navy intention on the Convair air-to-surface attack covering Fiscal 1961, which, when negotiated, is expected to provide a substantial dollar volume according to company sources. Its subsidiary, Perleco, Perleco & Miller, Inc., now has a backlog of approximately \$14 million in orders for its electronic data display systems and indicators so that the backlog will grow to approximately \$31 million by the end of 1968.

The subsidiary already has initiated a major subcontracting program so the order to Western Union facility, averaging some \$508,800 a week and it is expected to increase this program "substantially."

Acquisitions And Mergers

Proton Electronics & Development Corp., New York, has merged with Automatic Coil Co., Inc., Brooklyn, to expand its work in test equipment, coils, transformers and films.

After Corp., Woburn, Mass., has acquired the assets of and merged with Industrial Electronics Co., Inc., and Applied Dynamics Corp. First will continue under the other name and headquarters will be in Woburn, Mass., in Applied Dynamics' new plant. Allen Q. Mowitt, After chief, will continue as president, and Michael C. Strout, president of Applied Dynamics, becomes board chairman. John F. Mowitt, president of Industrial Electronics, is executive vice president.

Leid Electronics Corp. has acquired Alpha War Corp., which will operate independently as a Leid subsidiary. Peter Barone continues as president. Howard B. Schwartz has been elected executive vice president.

Financial Briefs

Fairchild Engine & Airplane Corp. reported a loss of \$123,000 or 11 cents a share for the first quarter of 1968 compared with a loss of \$177,800 or 9 cents a share in the 1978 first quarter.

Spartan Electronics Corp. looking in April initiated about \$1.5 million, a new high, and \$500,000 more than the company's February backlog. A large portion of the new business is for design and construction of electronic subsystems for data handling, missiles and space vehicles.



Only Cherry Gives You The Complete Line

Now

- ★ Serrated Stem Rivets
- with
- ★ Grip Markings on Rivet Head



The new Cherry "9000" Series MS type rivets are now a part of our standard product line, along with our familiar knock stem rivets.

Cherry is again FIRST to provide grip markings on the rivet head—for easy identification in blue or work lanes, plus positive visual inspection after installation.

Fully approved under MIL-R-18305A, Cherry "9000" Series rivets are available in your choice of metals, and are installed with existing serrated

stem pulling heads. For those who prefer serrated stem type blind aircraft rivets, the Cherry "9000" Series completes the line which includes the new Cherrylock "2000" Series Mechanically Locked Rivets with flush breakers, the Cherry High Strength Rivets—"400", "500", "600"—and the Cherry Standard MS line of knock stem rivets—the "150" and "840" Series. For information write: Cherry Rivet Division, Townsend Company, Box 2107-N, Santa Ana, Calif.

CHERRY RIVET DIVISION

SANTA ANA, CALIFORNIA

Townsend Company

ESTABLISHED 1910 • TRAYER PARK, PA.

In Canada: Forman & Bell Manufacturing Company, St. Catharines, Ontario

how Barber-Colman engineers meet critical tolerance and envelope challenge of Titan temperature control project

Assignment to Barber-Colman Company from Air Force TITAN associate contractor, AG Spark Plug, Milwaukee: Take one part of the Air Force TITAN guidance platform and develop a complete temperature control system that will fit into the odd-shaped, very limited space available. Hold temperature to the exceptionally close tolerances specified. Result: A precision Barber-Colman temperature control system incorporating an ingeniously formed set of compact control house and sensing element (right) which control temperature of the internal structure to within a few hundredths of one degree. Unusual assignments like this are the kind of challenge that Barber-Colman people like to accept. For help with your temperature control problems consult the Barber-Colman engineering sales office nearest your Baltimore, Boston, Fort Worth, Los Angeles, Montreal, New York, Rockford, Seattle.

FORM-FITTING TEMPERATURE CONTROL HOUSE FIT SMALL, IRREGULAR SPACE



Subplot control house and sensing element fit Air Force TITAN guidance platform into limited control area available



THE MARK OF QUALITY

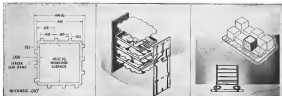
BARBER-COLMAN COMPANY

DEPT. E, 1420 ROCK STREET, ROCKFORD, ILLINOIS



AIRCRAFT AND MISSILE PRODUCTS, AIR VALVES
ELECTROMECHANICAL ACTUATORS, TEMPERATURE CONTROL SYSTEMS, POSITIONING
SYSTEMS, THERMOSENSORS AND THERMOSTATS, SPECIAL BRIDGING TEST EQUIPMENT

AVIONICS



NOMINAL DIMENSIONS of the seven units with shelled area mounted at periphery, designating surface area to be occupied by the space, a size to drawing at left. Arrive's view (center) shows various channels which comprise the Microminiature Module, including four wires, three spacers and two of four interconnection leads. Individual modules are interconnected on a unified common board (right) capable of accommodating eight modules in this case. Prefabricated metal connector fingers are inserted into the board holes and are then forced to the wiring to establish the interconnection.

Microminiature Modules Show Potential

By Barry Miller

Watkins, Man-A microminiature module program designed to accommodate contemporary as well as future high-temperature and high-density source components will be completed this week by Spylvania Electric Products, Inc.

With other microcircuit developments elsewhere, this program shares a common objective of efficient and reliable use within restricted volumes of the large numbers of components required in military and space systems. Systems engineers, for their part, are using materials, production techniques and a construction approach which they think will lead to microminiature development with growth potential—the ability to satisfy tomorrow's, as well as today's system needs. If, for example, a module whose upper operating temperatures are prefixed by those of available semiconductor components, is made by high-temperature fabrication techniques and employs high-temperature materials and leads, then the transition to higher temperature semiconductor devices, which may be made more extensively available within the next few years, will be an orderly one requiring no severe changes in the construction or assembly of the modules.

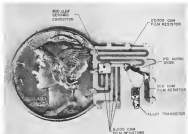
New to the development stage at Spylvania's Applied Research Laboratory here, the program has been entirely company-supported since its inception one year ago. To some degree the applications phase of the program will benefit financially from an Air Force

contract for the development of laboratory techniques for designing an ultra-reliable airborne receiver adaptable to microminiaturization.

This Wednesday Gerald J. Selva, Spylvania's manager of microelectronics, is scheduled to unveil details of the program before the Electronic Components Conference in Washington. Some of the principal features of the company's microminiature module, cited by Selva, are:

- Stage-to-stage interconnection without wires
- Functioning stage of circuitry on each wafer of the module
- Hermetic sealing of every wafer in the module without plastic or other painting components
- Construction of the modules by methods and with materials capable of withstanding temperatures up to 400 or 500C.

The microminiature module, like the



WAFER CIRCUIT supporting nine discrete components in precision receiver deposited metal film resistors, one capacitor, one diode, and one transistor—developed by a direct



WING TIPS



FIX HUBS. Check metric propeller regularly for slack and have them fixed promptly as soon as possible. Slacks can develop into cracks, and cracks can result in the breaking of main hubs in flight.



GET TIGHT. When checking the oil, make sure the dip stick is set in place securely. If it isn't in tight, the stick can work loose and oil may spray over the plane, causing serious loss of oil and a hazardous flying condition.



CHARGE IT. With an Esso Credit Card, you can charge gasoline, oil, lubricants—plus tire and battery service, landing fees, overnight aircraft storage, and more repairs. In addition, you can now charge Esso service and automotive products with the same card.

This convenience is yours at selected airports from coast to coast, and Canada, too. Naturally, top-flight service is provided by your dependable Esso Aviation Division, whose service is distinguished for your Esso pleasure and safety.

ESSO STANDARDS, Division of Humble Oil & Refining Company

Highways or Skyways...**ESSO RESEARCH** works wonders with oil!

Army RCA Micro Module will be built around a single, square-shaped water resistor on which components are mounted. Made of silicon or P-4000, each water can handle a current of five components, such as an excited transistor, vacuum deposited resistor and capacitor, plus conductors. The water has twelve molecular spaced tip connections which protrude from its outer perimeter. Once a circuit location has been assigned properly, and tested as the water, adjustable height spacer frames are glued onto the periphery of the water.

Alternate water and spacer are then successively stacked—water, frame, water, frame—under a dry inert atmosphere so that each circuit stage on each water is hermetically protected from the outside. Waters can be stacked to any convenient height, depending on the subsequent function of the module. The number of waters employed and the heights of the selected spacer frames determine the final height of the module.

Five rectangular P-4000 printed circuit interconnection boards are then fitted about the stacked water to form the module. Rows of dots on the interconnection board become the connecting points for adjusting tabs on the water. Connections among the individual circuits are established where conductive material protrudes on the water tabs is fused to the conductors on the printed circuit interconnection board, with a medium temperature, high-dielectric solder.

Component Density

The maximum packing density of the microcomputer module, compared on the basis of five parts per water, including one excited transistor per water, is expected to be 60,000 parts per cubic inch, according to Selvin. If component density was compared at 9 or 10 parts per water, logic, less conservative but still reasonable estimate for its component water density—then the parts density for Selvin's module would climb to about one million per cubic inch.

As for estimates as precise about potential or ultimate parts density with known functional or electronic elements are concerned, Selvin declines to get involved in what he and others working on superminiaturization are now calling the "member prove" or "members make." A more meaningful estimate of density or performance may come, Selvin hopes, which would relate the steps or circuit functions rather than components to unit volume. This would be especially useful for functional or molecular electronic circuits in which there will be no individual, identifiable components.

Selvin engineers are progressing

with a plan to demonstrate several types of operating module current. A 200 kc. flip-flop module is now operating. A broadcast band vacuum transmitter completely contained in a single water stack is under construction. In addition, work recently began on a high frequency (in excess of 50 mc.) and triple stage IF amplifier using silicon transistors throughout. With these three devices, which are expected to be fully functioning late this summer, the company hopes to demonstrate the versatility of its microcomputer module. These three examples, Selvin explains, will illustrate the same difficult low-frequency module type trends, as which

high selectivity and high impedance are mandatory, the simple, straightforward IF stage pulse occurs, the high frequency IF amplifier occurs.

Module Detail

The present working area on each water, 0.4 in., with an outside diameter of 0.4 in., is sufficient for at least five components of the type being built by various laboratories and studies for the Army RCA Micro Module program. Water thickness is 10 mils. Thus, each water can handle a great stage and the transistors can be made, test and adjust each stage action rather than individual compo-

POPE
PRECISION
BUILDS
2,000
DIFFERENT
motorized and
belt driven
SPINDLES
and any one
will lower your
production costs

Write for Bulletin B-32

POPE
PRECISION AND BELT DRIVEN SPINDLES
FOR EVERY PURPOSE

DESIGNED, ENGINEERED AND BUILT
PRECISION AND BELT DRIVEN SPINDLES
FOR EVERY PURPOSE

POPE MANUFACTURING CO. 1200 S. 10TH STREET, MINNEAPOLIS, MINN.
ESTABLISHED 1926

JUNE 20, 1960 Aviation Week



ART BY: [illegible]
[illegible]
AIR LAUNCHED BALLISTIC MISSILE

SAC IN TRANSITION

The changing role of the Strategic Air Command in the national defense picture will be featured on June 20th in a special 36-page report prepared by AVIATION WEEK editors with on-the-spot coverage of the SAC Command—The nation's shield against aggression.

This exclusive report will be published in answer to the growing requirement for an improved national understanding of SAC's changing role as the primary deterrent force guarding national security. The annual S&D issue will be devoted to this message which is today's most challenging subject.

The Strategic Air Command's deterrent position has undergone complex and fundamental changes in its transition to a Strategic Aero-Space Command—with its formidable bomber fleet now to be reinforced by intercontinental ballistic missiles operationally deployed to instantly register any aggressive action.

The transition of SAC is one of the most rapid and exciting events in the history of our nation and its defense. What SAC needs, what lies ahead and the weapons systems to be employed in the immediate future will be key subjects included in this first-time featured evaluation. The impact of new technologies and weapons systems has changed the entire defense concept and the response of SAC to these new requirements has been effective and positive.

AVIATION WEEK editorial teams are now engaged in the completion of the new SAC story—one that will generate world-wide readership. This issue, "SAC In Transition," offers commentators and suppliers of the aerospace industry an unusual opportunity to advertise and identify their role in the national defense effort.

A Special
Aviation Week
Report on the
Strategic Air Command's
Transition
into the
Aerospace Age

Aviation Week
and Space Technology

A McGraw-Hill Publication • 330 West 42nd Street, New York 36, N. Y.

© AVIATION WEEK, INC. 1960



Norden Contact Analog Display... man's sight beneath the sea

A recent and significant Norden achievement is a contact analog display which orients man in the sub-surface environment beneath the sea. This compact system provides a pictorial pathway for a submarine, displaying on a single screen all pertinent parameters: pitch, roll, heading, speed, surface and bottom position. It forms an integrated control station for the craft. A sophisticated electronic system utilizing advanced television and computer techniques, it was developed for the Bureau of Ships and brought from concept to hardware in less than 18 months.

This is just one of several key programs at Norden involving advanced television, radar, digital computers and digital control systems. And as man continues to probe his universe, Norden engineers will be helping to make his control easier and more efficient... for Norden is dedicated to extending man's capabilities.

Stimulating business are available at all levels of responsibility for qualified engineers and scientists.

NORDEN

DIVISION OF UNITED AIRCRAFT CORPORATION
Stamford, Connecticut

nant performance. Eventually, today's single circuit per solder is expected to give into multiple stages per solder with multielectron circuits.

(The 12 inch Army RCA Micro Module solder is 0.51 sq. inch and normally one component is affixed per solder, although multiple components, four instances, for example, have been mounted on one solder and R-C filters will similarly be assembled.)

Conductive material in the form of silver bonded glass frit will find some Sylvacon's solder in suitable patterns in television components. Each of the solder's higher protruding tabs (three per solder) has conductive material find into it also for subsequent interconnection with other solders, as previously indicated.

Soldering Process

After the event has been properly laid out and named, a glass using a glass cut both faces of the solder to improve the glass-to-ceramic bond in soldering. Spacer bases, 10, 34, 54 or more tabs in height (with 20 tabs sold without), are then fused in each solder by direct duration, high intensity, leaving performed under an inert atmosphere. Care is taken in selecting each spacer based on height at which solder must be able to clear the highest component in its solder. The various air Corning Pyroform which withstood temperatures up to 500°C. Sold area is then the 20 mil wall base around the periphery of each wire.

Components of the soldering process are limited by the maximum temperature which any of the mount components can endure, and where automatic devices are employed, this precludes the use of furnace techniques. But at the higher temperature accommodations are most available, different sold materials can be used to maintain the furnace soldering process up to 500°C. The not is the only limitation on the high temperature capability of the module and it can be changed within 60 days. In fact, Sylvacon sets the higher the temperature at which the test can be made, the broader the margin of safety of materials and the easier the processing.

This hermetic soldering of each circuit is one of the key features of the Sylvacon program, Solis contends. The entire circuit is protected in a single stroke, thus eliminating the need to protect the semiconductor in one way and other components in another. Plastic potting of a transistor, he argues, does not provide the superior long-term protection from moisture and contamination. This makes the true hermetic and essential. It also avoids such problems as the shattering of glass vacuum de-protected bulb, chemical attack, electrical leakage and dielectric effects and limitations in upper operating and

storing temperatures imposed by potting.

After a stack of hermetically sealed wafers has been assembled, each protected from one another and from the atmosphere, the laminates comprising boards are inserted over the tabs along the first length of the stack. Conductive wiring patterns, previously affixed and laid into the board, and the protruding tabs are fused together. A thin (2 to 3 mils) plastic coating is applied over everything except the ends of the board to protect the modules against moisture and abrasion. The resulting module is a half inch square rectangular shaped body whose length is, of course, dependent on the height of the stack.

Modules are then interconnected with a visible ceramic or fired Pyroform intermodule connection board, which is perforated with through holes for connections. A feature using pattern is precision etched onto one or both sides of the board and perforated metal connectors are inserted into the board holes and fused to the leadline wiring. According to the company, this provides a printed circuit representation without conductive bodies and plastic material which might peel, be deformed, or be temperature sensitive. Each of the intermodule boards can be plugged into a conventional printed circuit type of board connector.

In the event that spring type friction connection are undesirable, as they may be in some equipment, the spring connector fingers are protected with a solder shingle. Heat applied to the back side of the intermodule board fuses the intermodule module into the board. Because special materials are used throughout the bonding wiring and fingers are withstood temperatures comparable to those of conventional soldering for periods of time.

High Reliability

Schubert believes that the method of interconnecting modules and hermetically sealing each circuit promotes high reliability because of the purity of parts, the ruggedness of the plates, hermetic protection and the absence of wires.

Because the program is still in its infancy, Sylvacon has not an exact life test with the modules. In use, relatively long life, however, engineers loaded digital test, however, at 75 volts through metal film resistor stress an aluminum substrate for over 1,000 hr. before any degradation in the system was a loose glass covering to prevent dust from settling on the modules. There were no failures in any of the 42 strips tested with one unit degraded in this way. Test was run at room temperature and the heat of



AVAILABLE
IN A
COMPLETE
RANGE
OF SIZES

If you have applications involving bearings or transfer of motion, Spherco Bearings can supply your needs in a wide variety of materials with a quality that will give you long performance under normal or high speed conditions.



WRITE FOR
BULLETIN
257

SPHERCO
A PRODUCT OF
SEABRANT BEARING DIVISION
STEPHEN ADAMSON MFG. CO.
24 Ridgeway Ave. • Norwalk, Ct.

SOLID FOUNDATION

FOR YOUR GSE



Hamilton Standard's systems-engineering experience and technologies provide GSE resources of tremendous scope

Today Hamilton Standard can supply the widest range of aircraft and missile ground support equipment—down to precision components and safety devices to complete architectural structures and weapon sub-systems. This capacity stems from Hamilton Standard's 40 years' experience in systems-engineering in our laboratories and broadening product line.

IN SYSTEMS-ENGINEERING its facilities and products, Hamilton Standard has earned out new concepts in precision gaging, electrical and electronic control, automatic interlocks, and other safety devices that are essential to many of today's sophisticated GSE systems. These programs have also produced an unusual knowledge of structures, materials development, and such critical technologies as:

Electronics—Hamilton Standard's experience in producing controls for its products and laboratories is readily applicable to such GSE as check-out sets, simulation, computer, and electrical and electronic test equipment.

Hydraulics and Pneumatics—Through the development of hydraulic pumps, pneumatic propellers, starters, fuel controls, and aircraft air conditioning systems, Hamilton Standard has acquired comprehensive skills in hydraulics and pneumatics—skills that can be efficiently applied to many GSE products.

Cryogenics and Fuel Handling—Hamilton Standard is constantly working with low-temperature gases and fuels. This experience, plus extensive work with from air conditioning systems and fuel controls for liquid oxygen and liquid hydrogen, is a natural foundation for solving complex fuel handling or storage problems.

UNMATCHED RESEARCH AND DEVELOPMENT FACILITIES. As a division of United Aircraft Corporation, Hamilton Standard shares in one of the largest privately owned research institutions in the aerospace industry.

ONE SOURCE FOR ANY GSE. To learn how these facilities and services can serve you, phone or write Hamilton Standard, today.



HAMILTON STANDARD DIVISION OF UNITED AIRCRAFT CORPORATION

WINDSOR LOCKS, CONNECTICUT

SOME OF THE MANY FIELDS OF GROWTH AT HAMILTON STANDARD



HYDRAULIC CONDITIONING SYSTEMS for engine vehicles and such advanced as well as the 4-30, 4-30, 4-30 are featured systems of Hamilton Standard ground support.



ENGINE CONTROLS for over 20,000 aircraft to have been produced by Hamilton Standard. The company's latest designs work together advanced control engines.



STARTERS Over 10,000 pneumatic and hydraulic starters are in service on wings of the nation's largest aircraft. The new 40 lb. system, shown, permits direct weight, and average.

power dissipates most the surface temperature of the resistor is only 120°C. At the conclusion of the test, resistance values had changed by less than 1/18 of 1%, within the measurement accuracy of the test instruments.

As far as maintenance is concerned, a faulty module can be removed from the intermediate board and replaced by a functioning unit. The faulty unit can be discarded, or where it is necessary or economically desirable to repair the individual faulty circuit water, the interconnection board must be removed and the module repaired at the end of the bad water. With anticipated reliability, however, the failure frequency should shrink, Selva believes.

One of the more severe problems confronting any instrumentation program is the need to remove heat. In calculations and preliminary tests show, Synchro says, that thermal conduction by aluminum works directly to the interconnection boards is an efficient method of getting heat away from the active electronic materials and to a radiator surface with the lowest possible heat transfer resistance. Calculations indicate that well over one watt per module can be dissipated at 55°C ambient.

The only specific and valid test run thus far, Selva adds, involved a six-watt stack at about 50°C ambient in which one watt was dissipated on one water in the center of the stack. Under this condition the water surface temperature on which the sensitive metal film strip was dissipating as heat reached 55°C, a safe figure for a greenhouse transmitter. Additional water increased temperatures in the order of 54 or 55°C. Further tests are planned.

The Synchro measurement module is the product of a year's work by Selva's group which consists of what he describes as an integrated blend of transmitter circuit engineers, chemists, ceramicists, metallurgists and solid-state physicists.

In contracting for the development in the production stage with its modules, Selva plans to actively seek financial support from military agencies. The company feels that the application of microelectronics to military electronics today and to commercial electronics in the future makes this work essential.

NEW AVIONIC PRODUCTS

Components & Devices

• Synchro, Type UDS4-35-D-11G1, is a combination of any two of company's synchros from its past 5 and use 50 lines packaged in a cylindrical housing 2.875 in. long. Pictured unit is a control differential module. Stainless steel case.



— .937" —

struction provides necessary structural rigidity and size lineup is obtained by solder mechanical coupling. Alpha Precision Products Co., Inc., 9014 West Chasity Pike, Upper Darby, Pa.

• Static decoders, Type IN2941 and IN2950, designed for use as output relays in control applications are being offered by Delta Radio. These devices are capable of high speeds ranging from 100 to 4,000 relays per second and efficiency of 65 to 90% depending on power and control required. Phase control is accurate to 0.5 deg. and frequency control up to six parts per million is achieved under all load and environmental conditions, according to Delta Radio Division, General Motors Corp., Kokomo, Ind.

• Tunnel diodes, Type IN2941 and IN2950, designed for use as output relays in control applications are being offered by Delta Radio. These devices are capable of high speeds ranging from 100 to 4,000 relays per second and efficiency of 65 to 90% depending on power and control required. Phase control is accurate to 0.5 deg. and frequency control up to six parts per million is achieved under all load and environmental conditions, according to Delta Radio Division, General Motors Corp., Kokomo, Ind.



Systems competence in design, implementation, structural construction, installation, operation, training, and maintenance of:



1. Space surveillance systems



2. Transportable electronic systems



3. Instrumentation, control, and outfitting systems



4. Telecommunications systems



5. Integrated load, air, and air environmental systems



6. Data systems



ELECTRONICS
CONSTANTLY
AVAILABLE
—ANYWHERE

Alpha Corporation is an experienced supplier of transportable electronics systems and support packaging... is projects where the entire complex is transportable and where transportable units are part of a larger complex. Capabilities extend from design through implementation, final test, and customer orientation. Particular emphasis is directed toward reducing user problems through design compatible with human engineering factors and simplified maintenance.

The more than 700 engineers, technicians, and supporting personnel of Alpha represent a most substantial store of diversified systems experience.



CIRCLE 6 ALPHA DALLAS

AVIATION WEEK, May 7, 1968



SYSTEMS ENGINEERS, ENGINEERS, CONSULTANTS, WORLD-WIDE • RICHMOND, TEXAS • TELEPHONE DALLAS AREA 1-2191



HELICAL GEARS

Every M-D blower shipped has a matched pair of conventional, tapered helical gears. Both gears are 4000⁺ in 2021⁺. No other blower makes A/C quality.

WHY M-D ROTARY POSITIVE BLOWERS develop higher pressures!

The unique combination of precision manufacturing and modern design found only in M-D rotary positive blowers permits higher speed operation and higher pressures. For this reason M-D can furnish greater air flow at lower initial cost.

M-D blowers operate at wider pressure and speed ranges than any other rotary positive blowers. Capacities of 25 production models range from 50 to 4,000 CFM, pressures to 14 PSIG single, 70 PSIG multi-stage.



M-D BLOWERS, INC.
MADISON, WISCONSIN



A DIVISION OF KAYDON INDUSTRIES, INC.

each respectively. Both devices have typical pull-to-vacuity ratios of 3 to 1, can operate over temperature ranges from -50C to 100C, and are housed in TQ-18 size. The IN254H has typical peak point current of 3.3 amps (at 100V), total capacity of 50 proofshots while for the IN2969 these values are 4.7 amps and 20 proofshots, respectively. General Electric Co., Semiconductor Products Department, Syracuse, N. Y.



• **Binary encoder, Model 793 M**, is a 12-bit instrument that provides digital encoder packaged in a standard size 3 cm square measuring 1 m in diameter and 1.25 in in length. Unit has a resolution of 128 counts per input shaft revolution and a capacity of 4092 binary counts. A combination of two cascaded disks and 25 contact pickups provides serial or parallel binary output representing shift position or rotation. Lubequip Division, General Precision, Inc., 895 Western Ave., Glendale 4, Calif.



• **New transistors, Types IN1560 and IN2562**, capable of delivering 3 watt at 160 mc, are available for use in microwave transmitters, modulating devices, silicon rectifier radio transmitters, etc. With a collector current capability of 160 ma, the transistors are packaged in a gold-wired package to ensure low thermal temperature coefficients. These pop deflated junction transistors will dissipate up to 1 watt at 25C case temperature and are designed to meet mechanical and environmental requirements of MIL-S-19550. Motorola, Inc., Semiconductor Products Division, 3065 East McDowell Rd., Phoenix, Ariz.

• **UTUF Flexible Isolator, Model LI 91**, is designed for operation in the 400-470 mc band and can cover a bandwidth of 10 mc centered at 455 mc, providing more than 10 db isolation with less than 1 db insertion loss. Isolator measures 15 x 25 x 3 in including two BNC connectors and weighs about 5 oz. It is available for delivery with 10 to 60 db in microwave dissipation. Motorola, Inc., 4300 East McDowell Rd., Scottsdale, Ariz.

Instruments

• **Power meter, model B352T**, is a non-polarized compensated meter which measures continuous wave or pulsed RF power in free hole device reading ranges from 10 mW to 1 watt with constant in milliwatts at display.



Changing current operates from 10V to 125 v, 50 to 400 cps source. Readings are centrally dials for frequency, composition, modulation, and other stable than comparable measuring device, according to the firm, FNR, Inc., 2612 Strong Place, Woodside, TX, N. Y.

• **Cable tester, Model 196**, can measure cable leakage and continuity at a maximum rate of five tests per second on dot automatic operation. Tester will check 150 single circuits, 35 pairs or cables with any combination of number



of branch circuits to a total of 75 branches or any intermediate combination of main and branch circuits up to 150. Designed to meet MIL-T-341A, tests a bond in maximum, at night use. Callahan, Technical Industries, 1421 Old County Rd., Belmont, Calif.



POLISHING of sealing surface of lead glass electron tube bulb (left) is the most critical step in the polyepoxy sealing process being studied by Chrysler Electronics. Bulb is polished on ball joint scale of solid room inserts operating at 1,800 rpm. Microchamber helium light is used (center) to check positions of 84 between seating surfaces of tube bulb and ball joint stem. Infrared-ray or fringe patterns, give a visual indication of the consistency of the surface contour. At right a Type 1235 tube is ready to be vacuum-sealed by the polyepoxy process in a baking oven. Tube is mounted on test fixture and seal.



Optical Polishing Adds to Tube Reliability

By Harry Rarva

Longmont, 10—An optical polishing process of vacuum-sealing electron tubes located the number of rejects and significantly extended tube life as tests conducted on a pilot batch by Chrysler Electronics Division of Torrington Electric, Inc., under contract from U. S. Army Signal Supply Agency.

Until automated production equipment is developed, the process, called polyepoxy sealing, probably will be considered economically impractical except for sealing tubes in which high reliability is a major consideration in an airborne, missile system, unattended output stations and underwire cables. Army is expected to specify tubes sealed with the polyepoxy technique before the end of this year according to Ray, Glen Elmer L. Lantz, commanding general of Army Signal Supply Agency.

The process now characterizes tube application in sealing special types of tubes, including those made of diameters that given which have very high surface and strain points, and in sealing high precision quartz crystals.

Potassium type tubes sealed by optical polishing under present blow-off methods would cost approximately 115% more than if conventional gas flame sealing were used. This figure is based on the assumption that a nonoxidizing alloy would be sufficiently increased to compensate for the high labor costs incurred by using the process. At 2,000 in. at Chrysler Electronics' pilot operation, more than 60% of a batch of 36 polyepoxy-sealed Type

1235 miniature diode tubes, therefore tubes were still operating when all of a control batch of 50 flame-sealed 1235s had failed.

The polyepoxy tube is sealed in a baking oven. The tube is mounted on a holder which can be which all contaminants control during sealing are drawn off. The area to be sealed is controlled within an RF coil. A graphite ring is placed on the tube near the sealing surface at the sealing neck. The tube is then evacuated to a pressure of 2 x 10⁻⁶ mm of mercury and baked at 800C. The graphite ring is heated to 900C for 15 min by induction heating from the RF coil. Vacuum sealing prevents contamination of tube elements due to oxidation.

Graphite rings are subject to selective rapid erosion and are therefore not wholly satisfactory. Care must be taken to control ring contour, since variations in cross section are apt to cause variations in temperature, and



TUBE is placed in baking oven and evacuated within induction heating coil. Graphite ring is placed over sealing surface which is to be sealed.

prior sealing may be the final result. Type 1235 tubes were chosen for the evaluation of the sealing process because these tubes are made of hard glass with the maximum expansion close to the seal zone. In this type of construction the tube elements are particularly susceptible to damage, since hard glass tubes are subjected to relatively high and prolonged temperatures during conventional gas flame sealing, a method which has the following disadvantages:

- Oxidation of tube elements (including the cathode base metal, in some cases) can occur during sealing and mounting.
- Expansion in the heating gas may mechanically tube elements.
- Melted glass in the sealing area requires reworkments such as water cups, carbon dioxide and nitrogen which may be absorbed by the element surface.
- High temperature at the seal may cause material properties or even contaminants of the glass and contaminants of the elements including, at worst, the cathode surface.

As a result of these difficulties conventional production fields of the Type 1235 tube are exotic and reliability uncertain. Therefore this tube seemed a good choice for testing the polyepoxy sealing process.

Polyepoxy sealing is an application of the long known fact that a pair of high-polymerized and pre-cured-wired glass surfaces become strongly sealed by true molecular bonding when placed in contact. Campaigns General Electric Telegrapher-Signals (GSP) of Forest attempted to apply this sealing technique

friend or foe?



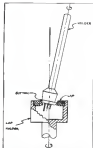
The way to know—An ominous shadow over scores of watchdogs...is an unidentified "bip" on a radar scope! A challenge from an airborne AN/APX-7 intercepting unit alerts into the other. In microseconds a reply identifies the potential intruder as friendly. The clearance of such a reply alerts the protection and retaliatory might of the nation.



ENGINEERING BEYOND THE EXPECTED Packard Bell's reputation as a leading designer and foremost producer of RF (radio-frequency, friend or foe) equipment is indicated by the fact that both the AN/APX-7 and the AN/APX-8, which transmit the reply, are products of our Technical Products Division. Advanced development, company-sponsored, has recently produced miniaturized RF modules which operate up to 300°C.

PACKARD BELL ELECTRONICS

Technical Products Division
15555 W. Olympic Blvd.
Van Nuys, CA, Calif. 91411, 2-5541



TUBE BUTT JUNCTION is held in a device made from a nonconductive stainless steel pin socket attached to a glass wall.

to tubes in which high reliability was desirable, as in submarine cables.

Due, apparently, to technical difficulties and economic reasons, the non-pipe method for a quartz optical sealing technique which proved satisfactory for making tubes in which reliability was paramount, according to Ward Weir, manager of Chloranne Electronics' power tube department.

The U. S. Army Signal Corps learned of the French company's process in 1956 and in June of that year awarded Chloranne Electronics a contract to produce, test and evaluate a quantity of tubes with polyepoxy seals. Chloranne Electronics made an agreement with CSP to obtain technical data and manufacturing knowledge. Army Signal Corps Supply Agency has awarded Chloranne Electronics a new contract to continue study of the vacuum sealing technique and reports that the results of this investigation will permit a decision as to whether volume production with polyepoxy sealing is justified.

The designation "polyepoxy" is a somewhat CSP descriptive term as "the union of sufficient per job epoxies" which translates as "system of sealing by optical polishing." Thus the American designation "polyepoxy sealing" is misleading.

"In Chloranne Electronics' polyepoxy sealing technique the mating surfaces of a Type 1218 tube's glass envelope and stem mount are optically polished to an accuracy of a few millionths of an inch so when they are joined the tube can be evacuated before the glass is fused.

The mating surfaces can be flat, conical or spherical, depending on the type of tube involved. A spherical seal design was selected for the Type 1218 tube. When a tube is made of soft glass (such as with low melting points) can be fused to the mating surfaces before polishing and the seal can be effected at relatively low temperatures. However, since the Type 1218 tube is constructed of hard glass, direct-contact sealing was required.

Polyepoxy sealing has three advantages:

- Oxidation is practically eliminated because the tube elements are under vacuum during sealing.
- Gas evacuation products consist only of the envelope.
- Metallic vapors and gaseous products driven from the glass are removed through the exhaust screen before they can appreciably contaminate the tube elements.
- Period during which the glass is heated to the softening point is only about 15 sec. (The quantity of contaminants released is a function of the time interval at sealing temperature.)
- Glass temperature during the sealing period is considerably lower than during gas flame sealing, so that fewer contaminants are released from the glass.
- Distortion of mount due to softening



ROUGH GRIND elements before to 0.20 in. (A) some lapping to 0.15 in. of the glass adjacent to the base glass is obtained.

• Pressure breakdown of the cathode holder is not critical because decompression occurs under vacuum conditions.

- Critical factors in polyepoxy sealing include:
- Polishing mating surfaces of the tube envelope and stem mount. Major disadvantage of the process is the cost of labor required to prepare surfaces.
- Sealing time: Too long a sealing time leads to bulb "neck in" in atmosphere pressure. Too short a sealing period results in leak seals, or cracks.
- Sealing temperature: Once below a minimum of 800°C before and during actual sealing was found necessary to prevent seal cracks.

COMPLETE FLOOR-TO-DOOR

DC-7 CARGO CONVERSIONS

IN 8 WEEKS, AT LOW COST

By year 80-1 for the DC-7 cargo conversion you must be flying today with a cargo cabin, and you'll probably have a better one in service.

We've already converted a number of DC-7s from passenger to cargo. (Chances are that you've heard of freighter conversions but not that we have converted air transport cargo planes into cargo planes.)

With 12 years experience in converting both major airlines and a 300 staff, we need no cargo carrier and can't sell only on our own, plus corporate and military.

Get the benefit of advanced LAS engineering, like the most individual conversion you can get. We'll give you the best price on the best conversion you can get. We'll give you the best price on the best conversion you can get. We'll give you the best price on the best conversion you can get.



LOCKHEED AIRCRAFT SERVICE, INC.
Ottawa International Airport, Ottawa, Ontario
Main Office • Montreal • Toronto • Vancouver • Seattle
CUSTOM AIRCRAFT • REPAIRS • MAINTENANCE • TRAINING • ETC.



**MORE BANG
PER DOLLAR FROM
THE LAND OF THE
SHELTERING PALMS**

Down where the lakes are only minutes away and the sea shore's just an hour's drive, Martin engineers come up with what is called a "pilot's aside!"—the air-to-surface Ballpop. It requires no more special handling than a round of ammunition. It gives the biggest bang per dollar in U.S. missiles.

Ballpop, operational with the Navy (GAM 65B in R&D with ADP), was designed and developed at Martin in sunny Florida. Ballpops are now rolling off production lines

for both the Navy and Air Force. Other Martin-Orlando prime contracts include: Learcon, Martin Master, and Poodling.

We think Martin-Orlando is doing outstanding work because it has outstanding engineers and scientists . . . and because it has facilities second to none . . . and because the man who can auto or jolt with his own in the evening brings renewed energy and purpose to his job. If you feel the same way about it, you'll feel at home in Orlando.

Write: C. H. Lang, Director of Employment, The Martin Company, Orlando 3, Florida, for a fully descriptive booklet, "Portrait of a Missile Maker."

CURRENT OPENINGS for engineers in these areas: ground and airborne electronics • advance design • systems • aerodynamics • quality and test • reliability • electronic manufacturing.

WORK IN THE CLIMATE OF REINVENTION

MARTIN
ORLANDO



GE Tests Radome for Radar Deflection

General Electric's Heavy Military Electronics Department is testing this prototype radome at Corvallis, N.Y. The dome is covered on a new radar test house built for the company by E. W. Bliss Co., Canton, Ohio. Tower, which has a flexible platform coupled to the steel framework, is used to determine amounts of deflection introduced into incoming radar signals by various types of radomes which house the antennas.

1970 FILTER CENTER 20222

• **New Transducer Company—Kendall** Scanconductor Corp. will be the name of the new scanconductor organization (AW Apr. 18, p. 112) set up by Kendall Division of General Precision, Inc. Stephen Gaffney and Robert S. Henderson, previously with Massachusetts Institute of Technology, will be president and executive vice president, respectively, of the West Newton, Mass. firm.

• **Signed on the Dotted Line—Mayco** contract search recently announced by various manufacturers include:

• **Raytheon Co.** will produce and install eight additional long-range anti-aircraft control radars for the Federal

Aircraft Agency under a \$6 million contract. This brings to 40 the total flight tracking radars ordered from Raytheon.

• **Richel Manufacturing Co.** will produce radars for Navy under a \$125,000 award from Bureau of Weapons.

• **Space Electronics Corp.** will conduct further research and development on Titan thermal guidance under a \$275,000 extension of a contract from Aero Corp.

• **Millership Co.** will produce electronic communications equipment for Strategic Air Command Boeing B-52 bombers under a \$12 million Air Force award.

• **Sperry-Globe Engineering**, Escondido, has received \$5.7 million for continued research and development on Sergeant weapons system from the Army Ordnance District, Los Angeles.



ENGINEERS SITE ACTIVATION

We're rolling up our sleeves for the most important step of activating bases throughout the United States. Design or design engineers with B.S. in M.E. or E.E. and experience in electrical or mechanical systems are required for liaison work at nearby launching complexes, or design support work on launch control equipment, propulsion systems, automatic programming and missile checkout equipment operations.

Assignments are at Warren Air Force Base, Cheyenne, Wyoming; Offutt Air Force Base, Omaha, Nebraska; Fairchild Air Force Base, Spokane, Washington; and in San Diego.

Please send complete resume to Mr. R. Newen, Engineering Personnel Administration, Dept. 120-90, 5599 Kerry Villa Road, San Diego, Calif.



CONVAIR/ASTRONAUTICS
CONVAIN DIVISION OF
GENERAL DYNAMICS



The sphere represents perfection in many ways to the designer of inertial instruments. It can be duplicated completely from signals due to external magnetic, electric, and gravitational fields. It has perfect symmetry, can be formed to extreme accuracy by simple machine processes. It is the primary element of Honeywell's electrically suspended gyro.

professional opportunities at Honeywell Aero

INERTIAL SYSTEM DEVELOPMENT

Systems Analyst—employs mathematical techniques such as operational calculus, matrix algebra, and difference equations to the solution of problems concerning performance characteristics of various system configurations including analysis for error introduced by sensors and computer, requirements for alignment, and optimization of the system configuration.

Digital System and Logic Design—requires familiarity with capabilities of various digital computer configurations and ability to employ system and logic relations in specifying necessary configuration for solving inertial navigation problems.

Electronic and Mechanical Designers—engineers with background in transistor circuitry, inertial sensor development and evaluation, and precision mechanical equipment design are needed to perform component development and evaluation, and to design mounting and alignment equipment.

APPLIED RESEARCH

Programmer Analyst—mathematician with experience in the use of medium and large scale digital computers for analysis of scientific problems.

Human Factors Engineer—capable of analysis and direction of experiments in human motor skills, and application to man-machine systems involving automatic control techniques.

Systems Analyst—capable of conducting research studies involving new techniques of space navigation and guidance.

DESIGN AND DEVELOPMENT

Flight Control Systems—analyst, system, and component engineers to work in areas such as advanced flight reference and guidance systems. Positions range from analyzing stability and control problems, systems engineering—through design, testing, and proof of electrical and mechanical equipment—including flight test and production test.

Advanced Gyro Design—Engineers with two and up to twenty years' experience in precision gyro and accelerometer development, servo techniques, digital techniques, sub-state electronic development, advanced instrumentation and magnetic component design.

Electronic Circuit Designers—experienced in the areas of analog/digital computers, transistor circuits, servos, instrumentation, and/or gyro stabilization.

For the best experienced professional engineers, there are opportunities in the Evaluation Laboratory which lead to careers in any of the above fields.

To investigate any of the above professional opportunities, please write in confidence to Bruce Wood, Dept. 6138, Honeywell Aerospace Division, 1630 Shown Blvd. N.E., Minneapolis 13, Minnesota.

Honeywell

 Military Products Group

To explore professional opportunities in other Honeywell operations close to coast, send your application to H. K. Aklonis, Honeywell, Minneapolis 8, Minnesota.

ENGINEERS

A NEW CONCEPT IN PROFESSIONAL JOB SELECTION

New technical tests enable you to calculate your probability for success at LMED—in 1 hour at your own home!

BY GENERAL ELECTRIC'S LIGHT MILITARY ELECTRONICS DEPARTMENT

If you're now thinking of changing your job some day—or in the next future—but have hesitated because of the many uncertainties involved, Light Military's new concept in professional job selection will be of permanent interest to you.

What is it?

The new concept is based on a series of technical tests developed and presented by Light Military engineers. They are designed to be taken, scored and evaluated by the individual engineer, all in the privacy of his own home. And, because the only purpose is to provide you with a merit, objective means for self-appraisal, your score need not be divulged to us at any time.

Here's how it works:

First, fill out the coupon below and check off the tests which apply to your training and professional experience. Forward the completed coupon to us and in a few days you will receive the tests, a sealed answer sheet and explanatory material.

During a convenient hour at home, take the test and score it with the answer sheet provided. Then, compare your performance with the criterion score composed of Light Military engineers at all levels who took the same test. In short, your score will be able to relate your score to years of experience, from 2 to more than 50.

What it measures:

If your adjusted score is equal to, or more than the years of experience you

possess, the probability is excellent that a significant community of technical interest exists between you and The Light Military Department. In addition, a valid assumption can be made that a high probability for success exists for you here. And remember, your score need not be divulged to us at any time. It is for your own guidance exclusively!

CURRENT AREAS OF ACTIVITY AT THE LIGHT MILITARY DEPT.

SPACE COMMUNICATIONS • TELEVISION • MOBILE & SATURN'S COMPUTERS • SPACE SHUTTLE ORBITERS • ORBITAL MANEUVER SYSTEMS • THERMOPHOTIC RAY STORAGE • SPACE RESEARCH & RECONNAISSANCE • REMOTE SENSING & SURVEILLANCE • REMOTE MUSIC APPLICATIONS

INFORMED BY CIRCULATED TO: 100000

Facts about the tests

- 1 Each technical test is composed of 40 multiple choice questions.
- 2 To find answers for some questions, mathematics is required—but only to the degree normally associated with the work.
- 3 The "mix" of questions is divided into four equal categories based on the type of the test.
- 4 None of our engineers achieved a perfect score.
- 5 The test for Engineering Administrative & Psychological, designed to reveal attitudes and abilities most often found in good engineering managers or administrators.

MAIL THIS COUPON FOR YOUR TESTS

Mr. R. Bach
Light Military Electronics Dept.
General Electric Company, French Road, Ulster, New York

Please send me tests (limited to 10 multiple per individual) answer and self-evaluation sheets covering the areas checked:

- ☐ RADAR ☐ MICROWAVE ☐ ELECTRONIC PACKAGING (ME)
☐ COMMUNICATIONS ☐ ADMINISTRATIVE ENGINEERING

NAME _____

HOME ADDRESS _____ HOME PHONE _____

CITY _____ STATE _____

DEPT. _____ PLEASED ACCOUNT _____



LIGHT MILITARY ELECTRONICS DEPARTMENT

GENERAL ELECTRIC 



EMPLOYMENT OPPORTUNITIES

The Advertising in Scientific Fields is an excellent opportunity for you to advance your career in the field of science.

Positions Vacant: Scientific Research, Engineering, Development, Design, Production, Sales, Marketing, Management, Administration, etc.

EMPLOYMENT

www.soc.com

EMPLOYMENT

For advertising rates in this section, call or write to: **Science & Technology**, P.O. Box 1111, New York, NY 10108. For more information, call or write to: **Science & Technology**, P.O. Box 1111, New York, NY 10108.

As an advertiser, you are assured of reaching a wide audience of scientists and engineers in the field of science and technology.

For more information, call or write to: **Science & Technology**, P.O. Box 1111, New York, NY 10108. For more information, call or write to: **Science & Technology**, P.O. Box 1111, New York, NY 10108.

Send your ad to: **Science & Technology**, P.O. Box 1111, New York, NY 10108.

You think circuit design is old hat?

We don't!

Give us feedback circuits which are "established" designs — we still find new aspects to investigate. Give us circuits to develop that must be reliable — we use the best available transistors, subminiature vacuum tubes, and other devices to design high performance circuits with feedback — for airborne and surface radar, comprehensive radar systems, communications and data processing systems.

Our circuit design groups are well balanced. We have talented men with a variety of capabilities, engineer supervisors who understand your problems. Among us are those who keep abreast of advanced theories in such fields as network synthesis, who also know when to apply them and when not, where calculating ends and breadboarding begins.

Our labs are broad new, technician support strong. There's a "quiet corner" for everyone. You have an opportunity to get the broad view — learn about the systems of which your circuits are a part, follow them through to systems test.

We're key members of an engineering organization, spending in nobody's shadow. If you share our attitude, let's compare interests. We always need creative circuit designers, and encourage engineers to develop in this direction and to take Company and university courses. Opportunities are on East and West Coast. Please write in confidence to: Mr. Donald Street, Management and Professional Recruiting, Equipment Division, Raytheon, 624K Worcester Road, Framingham, Mass.

EQUIPMENT DIVISION



WILLING TO
RELOCATE



Are you a computer programmer and don't know it?

Many men who have training in engineering and the sciences are now going into computer programming. They find that it makes full use of their special analytical and logical talents, often not fully tapped in their present work.

In the 60's and beyond, the electronic computer will become more and more an important factor in the operations of business, industry, science and government. Computer programming is the man who it is that the computer is not just a vital role in this progress.

One of the most important qualifications for this work is the ability to analyze complex problems and to reduce them to their essential logical and useful elements.

A computer programmer takes a problem — it may be in engineering, science, marketing or in any of dozens of other fields — analyzes it, and shows it in a mathematical language that the computer can "understand." Then the computer goes to work with its pitiless speed and accuracy.

If you qualify as a computer programmer, you will be given an intensive training course in machine language, about program development, problem solving techniques and efficient writing.

If you have a degree in engineering or one of the sciences, and are interested in this important new profession, I will be happy to give you further information.

Please write nothing less than your best ground to:

Mr. D. H. HARRISON, Dept. 124022
IBM Corporation
7220 Wilcoxon Ave.
Bethesda 14, Maryland

IBM

INTERNATIONAL BUSINESS MACHINES CORPORATION



perations Research Scientists:

Need time to develop your ideas?

Most scientists engaged in operational research work, want to feel that they cannot do their most productive work when they are constantly fighting operational deadlines.

The operations research programs at Systems Development Corporation are carefully planned to provide a safe harbor for the development of new ideas that apply to the development of large-scale, computer-based information-processing systems.

The following are just a few examples of the areas in which Operations Research Scientists work at SDC: (1) simulation and operations planning techniques in problems of control systems; (2) mathematical logic applied to universal computer languages; (3) medical decision processing; (4) machine modeling of man-machine interactions; (5) logistics; (6) and design for operational computer programs.

Operations Research positions are now open for scientists at several levels of experience. Please send your inquiry to Mr. E. A. Shaw, SDC, 2401 Colony Avenue, Santa Monica, Calif.

Applicants of Computer Simulation to Production System Design, "a paper by Allen J. Rowe, is available upon request. Send request to Dr. Rowe at SDC.



**SYSTEM DEVELOPMENT
CORPORATION**

Santa Monica, California • Los Angeles, New Jersey

LETTERS

Budget Limitations

The recurrent plea of Attorney Weiss for more defense funds raises certain questions which ought to be answered by the editorial staff.

[illegible]

I think one debate spending race has won: that we give up to get the extra half-cent and waste money! Remember, the USRAA can keep up the present .001% tax indefinitely. I feel that NY could do a lot better if a complete defense policy could be provided, not instead of words only for more money. It was one idea that such a small policy is the push for the politicians of the majority, that is not really the problem of a more defense funds, also limited to more money.

I do not like the President's insistence on making defense funds run over the the ceiling of \$275 billion and not let consumers take the off-invoice cost and perhaps the best reason on the budget is just as much a defense (allowing defense) effort is a small is, a few more billions (and some right—more inflation, so reduced value of the dollar) for better weapons and aircraft.

NIEL F. JOHNSON
State College, Calif.

Pilot Problems

Your publication of Apr. 4 carried a letter headed "Pilot Complains" (p. 146). I wish to agree with Mr. Wachtel's letter, stating "Nobody knows a pilot's job like he's piloted."

We got on the power and he, as hard as possible, following us a small fraction of the way as well known both of pits.

1. **Moving.** Near the whole pilot structure is built on stilts, it's a kind of crane that moved later. It has some more machines of traps on cranked at a bay. The great pilot will be displaced and will be in more big and bigger. He was chosen to connect to see his family from his son, especially which might get him as much as one or two days a week at home. They

Adoption Week welcomes the opinions of its readers on the issues raised in its companion's editorial columns. Address letters to the Editor, *Adoption Week*, 220 N. 42nd St., New York 28, N. Y. Try to keep letters under 300 words and give a precise identification. We will not print anonymous letters, but names of writers will be withheld on request.

is, with no records at that time, in the index, can eliminate or extend the time at our airport. Not much has moving as much as two, a year.

[illegible]

1. **Sickness:** I know of one pilot who had not been ill for four years. The medical record was so scheduled the officer wasn't thinking too far ahead because he answered the phone—and he said there is some talking still. This medical man to do some, and stated that they would send a doctor around to check on his case if he didn't go.

4. *Prokaryotic* - eukaryotes. Recall both, to living up (that was subject) but there is no point that I could list. My Wombat is a domestic! On a somewhat sad, a pilot is reported to perform a common maneuver that he has not done for over half a year. Granted a man must be able to cope with an aircraft at low times, but to be asked to perform a pilot: strap those without passengers is asking a lot.

3. Time: Since 30 to 60 months is the maximum goal of action, plots the amount he can rightly expect. This time, the father is, can call his life his own. In order to reach the maximum time shift it is not an

constant for a mile to get as much as 70¢ for an extra gas month. Quite high, a large

It is true that the average water intake rate is 100 l per month. When an average is figured on the date time it comes to \$1.40 per l for a variety of people and this goes down when a freshwater rate is made as \$1.40 per l and no phosphate is added to gas.

When you are better in the long long there is a link, also that you can do but it is however the most for people who are not, and long times are not, is good in their best (strong).

Environ. Foreign Unvers.
Antoni Caproni
Brescia N. 5

It is. Please excuse the terrible writing. I'm presently deadwooding in the back of a place as pathetic as I had to get this to you as soon as I could the letter.

Specialized Duties

In the Apr. 6 publication (p. 146) there was an intelligent letter from a Mr. A. J. Winst. It is refreshing to read an article supported by safety and common sense in being

The unions have built up their business on the confidence of the paying passengers who expect to be treated to a safe trip and a full staffed efficient crew in top protection. People place the same confidence in the reputation of an airline and the re-

The number of people living in still cows, partially wild and pure if they are, is in the United States less than would be if we were in groups of men from the 19th century with only one cow. The people who are able to graduate to pure cows are those who are able to live and work in the wild and not afraid to use it that they are, advised to.

As a further indication, I experienced some quick responses: boys during school hours, one member had his hands full performing the specialized duties assigned to him alone. On these days the spirit of cooperation was obvious and unimpaired; these intelligent men showed the greatest perception regarding rules and common sense in living as well as in respect for their

Follow your instincts and their performance of these important duties. These fish don't mind, you wonder about the pilots who start to be Jack of All Trades.

FORREST, STEVENSON
Corky Ridge, Pa.

Defense Position

Although these comments may have been intended as sarcasm or merely provocatively, one cannot avoid but get displeased in the feeling that the present and future defense position of the United States is suffering more often from a combination of the following:

21. An Ambassador that is reluctant to follow the recommendations of most of the appeals has lost qualified subject personnel (see Table 1).

Issue	Foreign Affairs
Volume	Cape
Page	5

It is. Please excuse the terrible writing. I'm presently deadwooding in the back of a place as pathetic as I had to get this to you as soon as I could the letter.

Multi-Use Automated Maintenance



Formerly *Strophomena*
Clerks: Walter, Ed.

The recent demonstration of multi-purpose test equipment (MUPTK), developed by RCA under a series of Army Ordnance contracts, highlights a new dimension to automated missile test support and eliminates a long-term RCA effort in this field. This General Evaluation Equipment is an automated, transistorized, dynamic checkout system. It contains a completely modularized array of electronic and mechanical

evaluation equipment, capable of checking a variety of electromechanical devices ranging from radar subassemblies to missile guidance computers. MPTE provides the stimuli, programming, control, measurement and test functions for the NIKE AJAX, NIKE HERCULES, LACROSSE, HAWK and CORPORAL missile systems and has been extended to other weapons systems related to our defense efforts.



RADIO CORPORATION of AMERICA

DEFINITE ELECTRONIC PRODUCTS
CANNOT BE NEW IDEAS

SM/I PRESENTS

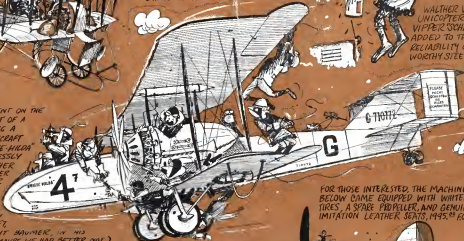
OF RELIABILITY



THE QUESTION ARISES "HOW FAR CAN RELIABILITY BE CARRIED?" ACCORDING TO L. VIANCONI ITALIANO, CO-DESIGNER SALVATORE-BONFIGLIORI AND BARTOLOMEO SAVONI REMAINED APT 6 YEARS IN THEIR UNLIVE FRESH AIR MACHINE "THEY EVENTUALLY WERE SAFELY SHOT DOWN BY A GOVERNMENT AIRCRAFT TO PREVENT THE CONTINUATION OF THEIR EXTREME HUNGER."



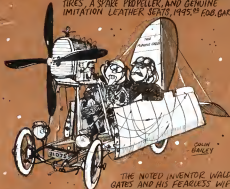
THE DISTRESSING EVENT ON THE RIGHT WAS THE RESULT OF A RELIABLE CREW FLYING A QUOTE UNRELIABLE AIRCRAFT THE UNL-FATED 'DESSA-HUDA' FLOUNDERING HOPELESSLY OVER THE BALTIC, HER AILERONS AWRY, HER NAVIGATING OFFICER TRYING DESPERATELY FOR A FIX AND THE REST OF THE CREW TRYING DESPERATELY TO FIX THE AIRCRAFT. — TO QUOTE COUNT BAUMER, IN HIS MEMOIRS... (WELL, MAYBE WE HAD BETTER NOT.)



FOR THOSE INTERESTED, THE MACHINE BELOW CAME EQUIPPED WITH WHITEWALL TIRES, A SPARE PUMP, AND GENUINE IMITATION LEATHER SEATS, 1945, F80, GARY.



SIR WIMBLEDON ROOKE, NOTED KNIGHTHOOD, BON VIVANT, AND PRESIDENT OF ROOKE ENTERPRISES, GAVE HIGH PRAISE TO HIS WHOLE "CLASS FLYING-BUAT, IN HIS BOOK "THE LADDER OF SWIMMERS" BUT HASTENS TO EXPLAIN IN CHAPTER 5 THAT AS TO THE QUESTION OF RELIABILITY, IT WAS HIS EXCELLENT DEPENDABLENESS TO WHICH HE WAS REFERRING.



THE NOTED INVENTOR WALDO GATES AND HIS FEARLESS WIFE MINNIE IN THEIR 'ZUE NOBILE' WHICH, AFTER EXTENSIVE TESTS, PROVED A MOST EXCELLENT MACHINE, FOR HUSING COOL.

Free reprints of this series available upon request. Write Dept. A at SM/I.

1960—RELIABILITY: typical of the reliable components which were used in SM/I's first air data computers and other complex subsystems was our line of vacuum tube amplifiers, which exhibited a mean life of 11,000 hours. Today, systems and components such as SM/I's True Air Speed Computers, LOX Tanking and Propellant Utilization Systems and Force Balance Transducers are demonstrating comparable reliability for the more stringent requirements of modern weapon systems.

SM/I

SERVOMECHANISMS/INC.

LOS ANGELES DIVISION: 12800 Aviation Boulevard, Hawthorne, California
MECHATROL DIVISION: Westbury, New York
RESEARCH DIVISION: Golata, California

Subcontractors to leading system managers... Aircraft and Missile Instrumentation... Ground Support and Test Equipment... Fuel Management... Systems, Subsystems and Componentry. Positions available for qualified scientists and engineers.

